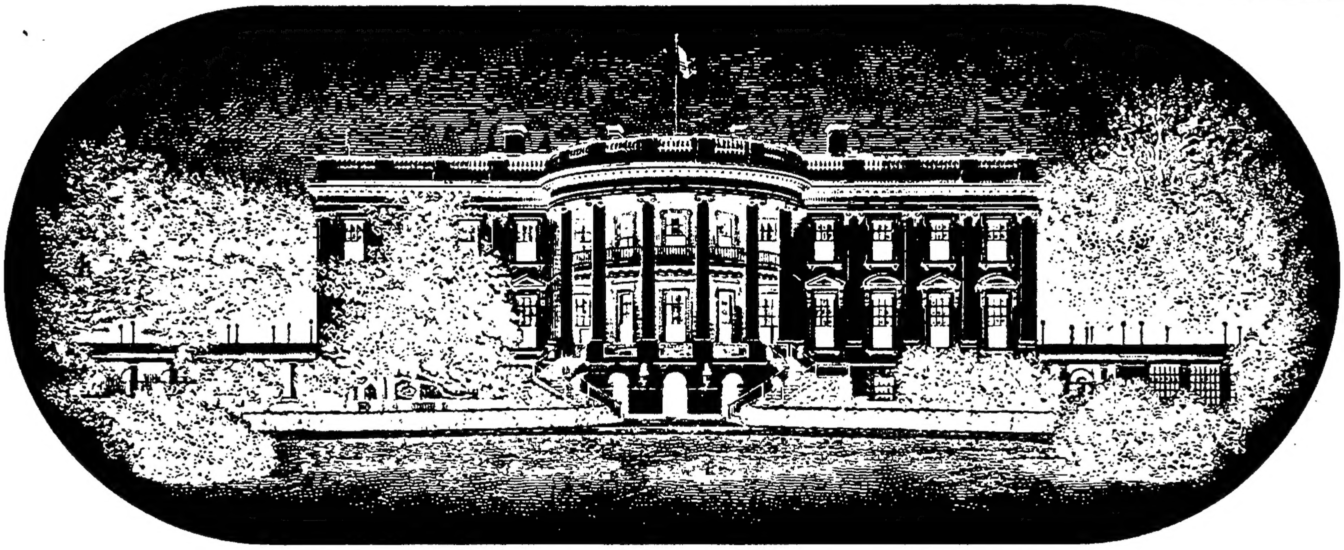
PB84-173269

President's Private Sector Survey on Cost Control: Report on Research and Development

President's Private Sector Survey on Cost Control, Washington, DC

1983

PB84-173269



PRESIDENT'S PRIVATE SECTOR SURVEY ON COST CONTROL

REPORT ON

RESEARCH AND DEVELOPMENT

APPROVED BY THE SUBCOMMITTEE FOR THE FULL EXECUTIVE COMMITTEE, WINTER 1983

BIBLIOGRAPHIC INFORMATION

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PERFORMER: President's Private Sector Survey on Cost Control, Washington, DC.

The report represents the results of the Research and Development Task Force of the President's Private Sector Survey on Cost Control in the Federal Government. The Report on Research and Development contains major recommendations which, when fully implemented, could result in three-year cost savings of $45.074 billion, including $32.984 billion in savings and revenue opportunities contained in other PPSSCC Reports. It should be noted, however, that some of the recommendations may require several years for the savings to be realized. While all facets of Research and Development could not be surveyed in the time allotted, areas selected for review were considered to offer significant potential for cost control and improved efficiency.

KEYWORDS: *Cost control, *National government.

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THE PRESIDENT'S PRIVATE SECTOR SURVEY ON COST CONTROL

January 20, 1984

The Honorable Ronald Reagan
President of the United States
The White House
Washington, D.C.

Dear Mr. President:

The following Report represents the results of the Research and Development Task Force of the President's Private Sector Survey on Cost Control in the Federal Government. The Task Force was chaired by William F. Ballhaus, President, Beckman Instruments, Inc.; Karl D. Bays, Chairman and CEO, American Hospital Supply Corp.; James L. Ferguson, Chairman and CEO, General Foods Corp.; David Packard, Chairman, Hewlett-Packard Co., and Edson W. Spencer, Chairman and CEO, Honeywell, Inc., with Eugene E. Yore serving as Project Manager. The report culminates the combined efforts of 30 individuals who devoted extensive pro bono work to the PPSSCC initiative. A list of all Task Force members is enclosed with this letter.

The Report on Research and Development contains major recommendations which, when fully implemented, could result in three-year cost savings of $45.074 billion, including $32.984 billion in savings and revenue opportunities contained in other PPSSCC Reports. It should be noted, however, that some of the recommendations may require several years for the savings to be realized. While all facets of Research and Development could not be surveyed in the time allotted, areas selected for review were considered to offer significant potential for cost control and improved efficiency. The importance of the accompanying recommendations rests on the fact that they represent the potential for better utilizing finite resources available to the Federal Government.

Clearly, other opportunities for cost savings and revenue generation exist but, due to limited time and personnel resources, they could not be pursued. Several are suggested for further review because they offer future potential savings and revenue opportunities.

On behalf of the Co-chairs and Task Force members, I would like to express our deep appreciation for the opportunity to have been of service to you and the members of your Administration.

Respectfully,

Peter

J. Peter Grace
Chairman, Executive Committee

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PRESIDENT'S PRIVATE SECTOR SURVEY ON COST CONTROL

REPORT ON
RESEARCH AND DEVELOPMENT

APPROVED BY THE SUBCOMMITTEE FOR THE
FULL EXECUTIVE COMMITTEE, WINTER 1983

PREFACE

On June 30, 1982, President Reagan signed Executive Order 12369 formally establishing the President's Private Sector Survey on Cost Control (PPSSCC) in the Executive Branch of the Federal Government. An Executive Committee under the chairmanship of J. Peter Grace was established, consisting of 161 high-level private sector executives--mostly chairmen and chief executive officers--from many of the nation's leading corporations.

Briefly stated, the President directed the PPSSCC to:

- Identify opportunities for increased efficiency and reduced costs achievable by executive action or legislation.
- Determine areas where managerial accountability can be enhanced and administrative controls improved.
- Suggest short- and long-term managerial operating improvements.
- Specify areas where further study can be justified by potential savings.
- Provide information and data relating to governmental expenditures, indebtedness, and personnel management.

The Executive Order also provided that "the Committee is to be funded, staffed and equipped . . . by the private sector without cost to the Federal Government." To implement this objective, the Foundation for the President's Private Sector Survey on Cost Control was established. It formed a Management Office which organized thirty-six "task forces," each co-chaired by two or more members of the Executive Committee, to do the "preliminary reports."

Twenty-two of these task forces were assigned to study specific departments and agencies, and the remaining fourteen studied functions cutting across Government such as personnel, data processing and procurement. In addition to individual task force reports, the Survey Management Office has issued a series of reports on selected issues. Apart from the Executive Committee in its official capacity, none of the task force members had any authority to make recommendations to departments and agencies or to the President.

A listing of the thirty-six task forces follows:

Agriculture
Air Force
Army
Automated Data Processing/Office Automation
Boards/Commissions-Banking
Boards/Commissions-Business Related
Commerce
Defense-Office of Secretary
Education
Energy (including Federal Energy Regulatory Commission and Nuclear Regulatory Commission)
Environmental Protection Agency/Small Business Administration/Federal Emergency Management Agency
Federal Construction Management
Federal Feeding
Federal Hospital Management
Federal Management Systems
Financial Asset Management
Health & Human Services-Department Management/Human Development Services/ACTION
Health & Human Services-Public Health Service/Health Care Financing Administration
Health & Human Services-Social Security Administration
Housing & Urban Development
Interior
Justice
Labor
Land, Facilities and Personal Property
Low Income Standards and Benefits
Navy
Personnel Management
Privatization
Procurement/Contracts/Inventory Management
Real Property Management
Research and Development
State/AID/USIA
Transportation
Treasury
User Charges
Veterans Administration

Each of the 36 task forces prepared a draft report and, with a few exceptions, an appendix, supporting the recommendations contained in the task force report. Those appendices are on file at the Department of Commerce's Central Reference and Records Inspection Facility. It should be noted that recommendations relating to any one federal agency may be included not only in the appropriate agency task force report but also in the reports of the functional cross-cutting task forces.

It is important to note that cost savings, revenue, and cash acceleration opportunities in this report may duplicate similar dollar opportunities reported in other task force reports. Thus, there may be instances of double counting of dollar opportunities between task force reports. These duplications will be netted-out in the Final Summary Report to the President. Additionally, dollar estimates in this report are based on reasonable and defensible assumptions, including standard three-year projections based on when first, second, and third year partial or full implementation will occur and not specific fiscal years. Accordingly, estimated savings or revenue opportunities are understandably of a "planning" quality and not of a "budget" quality. Therefore, the reader should guard against drawing conclusions or making dollar projections based on the disclosures contained only in this report.

A glossary of terms used in categorizing PPSSCC-identified opportunities follows.

- <u>Cost Savings include:</u>

Cost Reduction	- reduction of budget expenditures, generally ongoing
Cost Avoidance	- avoidance of cost for anticipated but unbudgeted expenditures, generally ongoing

- <u>Revenues include:</u>

Revenue Enhancement	- increased receipt of existing or new revenues, generally ongoing
Revenue Acceleration	- sale of fixed asset for cash, generally one-time

- <u>Cash Acceleration includes:</u> - improvement of the cashflow, generally by accelerating the cash inflows and/or decelerating the cash outflows. Generally ongoing, but may be a one-time occurrence.

The standard three-year projections of cost savings and revenues include 10% inflation in Years 2 and 3. On revenue accelerations and cash accelerations, savings are claimed on the interest avoided which is estimated at 10%. These rates reflect generally prevailing rates at the time the Task Force reports were prepared and may be adjusted, as necessary, in the Final Summary Report to the President.

In addition to identifying specific opportunities for cost control and improved efficiency, PPSSCC sought to identify the appropriate implementation authority for each recommendation. Because of the complexities of the appropriations process, as well as historical precedents, however, further data could result in a change in the PPSSCC-identified authority.

All of the PPSSCC reports were considered and acted upon in a meeting open to the public by a Subcommittee of the Executive Committee of PPSSCC, along with other statements and recommendations. Written comments submitted by the public, if any, have been forwarded to the White House along with the final PPSSCC reports. In addition to individual reports, the PPSSCC Executive Committee will adopt a Final Summary Report to the President, summarizing the scope of its individual task force recommendations and offering general conclusions and advice. This Summary Report is tentatively scheduled for release in late Fall.

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EXECUTIVE SUMMARY

FEDERAL RESEARCH AND DEVELOPMENT

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Corporate Director
Honeywell, Inc.

NUMBER OF TASK FORCE MEMBERS: 31

NUMBER OF ISSUES: 8
RECOMMENDATIONS: 122

THREE-YEAR FULLY/PARTIALLY SUPPORTED, COST SAVINGS/REVENUE GENERATION:
($ millions) $45,074.0

(Note: This Report contains a compendium issue covering R&D issues from other reports. It includes 97 recommendations with three-year cost savings/revenue generation of $32,984.2 million.)

RESEARCH AND DEVELOPMENT OVERVIEW

Research and development (R&D) in the Federal Government is conducted primarily by five agencies which together account for 93.2 percent of the total FY 1983 R&D budget of $44.3 billion. These agencies are the Department of Defense (DOD), National Aeronautics and Space Administration (NASA), Department of Energy (DOE), Department of Health and Human Services (HHS), and National Science Foundation (NSF). The R&D funded by these agencies is conducted by industrial firms (52 percent), Government laboratories (24 percent), universities (11 percent), Federally funded research and development centers (9 percent), and others (4 percent). There are over 700 laboratories employing more than 206,000 personnel which conduct the 24 percent of the R&D performed in-house.

OVERALL PERSPECTIVE

The Task Force was favorably impressed with the high quality of R&D managers in the Federal Government -- the

Presidential appointees, senior executives and R&D civil servants. They are skilled and work very hard at R&D management. Open and cooperative attitudes with interest in improvement were prevalent. Yet within this overall environment, some very important problems were found and a great deal of room for improvement was identified. Specifically, the Task Force identified the need for agency top management to become much more actively involved in establishing the specific goals for R&D in terms which are clear, precise, and measurable. Also, this lack of direction to substantive aspects of R&D and a budget process which severely inhibits the management process combine to create a system which cannot establish program priorities and which results in a great deal of program instability.

ISSUES AND RECOMMENDATIONS

The Task Force selected eight issue areas to survey and formulated recommendations which, when fully implemented, could result in three-year cost savings and revenue generation opportunities of $45.1 billion. One of the eight is a compendium of R&D issues from 14 other task force reports. This compendium issue incorporates 97 recommendations with $33 billion in three-year cost savings and revenue generation opportunities. In the other seven issue areas surveyed, the Task Force formulated 25 recommendations which, when implemented, could result in three-year savings opportunities of $12.1 billion.

It should be noted, however, that some of the recommendations may require several years for the savings and revenue to be realized. While all facets of R&D management could not be surveyed in the time allotted, areas selected for review were considered to offer significant potential for cost control and improved efficiency. The importance of the accompanying recommendations rest on the fact that they represent the potential for better utilizing finite resources available to the Federal Government.

Strategic Planning -- R&D management suffers from a lack of clearly defined goals. Existing planning efforts do not establish priorities for R&D programs, cannot eliminate marginal programs, and do not serve as a base for operational management. Most existing plans are compendiums of pet projects derived from lower levels in the organization and do not reflect a coherent approach to meeting specified goals within the constraints of available resources. Specific Task Force recommendations to alleviate the above findings would result in three-year cost savings of $7,300 million. These recommendations include:

- focusing efforts by top management on the development of clear, measurable statements of R&D goals in their respective agencies;
- developing systems necessary to translate the goal statements into complete plans; and
- committing to the use of the strategic plans to guide the operations of each agency.

R&D management and the Budget Process -- The budget process used to obtain funding for the R&D programs is too cumbersome and time consuming. The three-year budget planning period is a factor in the significant cost growth experienced in R&D programs. For example, presenting an R&D budget for DOD, NASA and DOE in terms of 1,822 individual projects creates tremendous burdens on the agencies and creates a situation which invites micromanagement. To remedy these deficiencies, the Task Force recommends the following actions, which would account for $3,670 million in savings opportunities over three years:

- Implement multiyear budgeting specifically for R&D activities.
- Use a budget activity structure that significantly reduces the current level of detail required for R&D programs.
- Shorten the budget cycle.
- Reduce technical staff positions in R&D agencies.

Privatization -- In its review of R&D activities, the Task Force was aware that there were several opportunities to privatize Federal R&D efforts. Other task forces suggested private funding for the fifth shuttle, privatizing the National Fertilizer Development Center, and getting DOD labs out of advanced development work on weapon systems. The DOE Task Force recommended that the Government cease funding activities that do not fit within the framework of Federal responsibilities for R&D, including the Clinch River Breeder Reactor. In the view of the Task Force, a concentrated analysis of privatization opportunities would result in the identification of billions of dollars in potential savings.

Management of Federal R&D Laboratories -- All R&D literature cites the "over 700 Federal R&D labs," which are an integral part of the Government R&D program. This Task Force found that 90 percent of the operating costs are used by the 146 labs with more than 100 employees. The other

600 "labs" are small facilities, two-thirds of which have fewer than 25 employees. In reviewing some of the major labs, the Task Force found some with outdated facilities and equipment, all with personnel problems, and no formal system for evaluating the laboratories' contribution to the agency's program(s). The Task Force makes seven recommendations to improve the labs' performance, including greater use of "centers of excellence," a concept which concentrates research resources to achieve a critical mass in selected areas. Savings opportunities of $506.4 million over three years were identified.

Administration of Research Grants to Universities -- An increasing percentage of the money going to universities to conduct research for the Federal Government is used to cover the indirect costs of the research. The largest elements of these indirect costs are the three administrative components (departmental administration, general and administration, and sponsored project administration). Past efforts to negotiate an approach to handling these cost elements have not been entirely successful and have resulted in a system which is a major burden to the universities and a major area of contention between the two parties. The Task Force recommends that the Government and the universities negotiate a fixed rate beneficial to both parties to reimburse these costs. Because of the reduced burden this would place on the universities and because of a fixed limit on this element, the Task Force estimates savings opportunities of $387.9 million over a three-year period.

Research Program Reporting -- The Task Force found that current efforts at reporting ongoing research efforts were incomplete and that the system which processes the data, the National Technical Information Service, did not have the tools to expand the reporting. Three-year savings opportunities of $225 million would occur if:

- use of the data base were made mandatory, and

- requirements were implemented to ensure research performers supplied the information.

NASA Cost Reporting -- Space project cost data reported by NASA was found to be significantly understated since NASA does not include Civil Service and other essential cost elements in its reporting. Recommendations have been made for over ten years to expand the project management and reporting systems to cover these costs. The Task Force believes that NASA's reasons for these omissions are inadequate and recommends that all project costs be managed and reported in the same system. No specific savings opportunities were identified with this management improvement recommendation.

IMPLEMENTATION

Of the 25 major recommendations formulated by the Task Force, 18 (72 percent) are entirely within the purview of the Executive Branch and 7 (28 percent) will need Congressional approval. (Implementation authority for the 97 recommendations covered by the compendium issue is included in the individual Task Force reports.) All of the recommendations dealing with strategic planning can be implemented within Executive Branch authority. Because of the nature of the recommendations dealing with R&D management and the budget process, Congressional approval will be required. Most of the other recommendations can be implemented within the Executive Branch.

SUMMARY

The Task Force's recommendations focus on overall management rather than its detail. Economic benefits associated with those recommendations are believed to be a conservative evaluation of what the nation might gain if Federal R&D management assumed a more businesslike approach. If all of the people involved concentrate their efforts on overcoming the problems that have been identified, other benefits, whose value is hard to quantify but which surely must be measured in additional billions, will accrue to the American economy and society.

THE REPORT RECOMMENDATIONS -- A PERSPECTIVE

As the product of an unprecedented and wide-ranging survey performed in a political atmosphere by private sector executives and specialists, the recommendations in this Task Force report must be placed in perspective. Our volunteer staff had the formidable task of bringing its expertise to bear on complex Federal operations in the short span of a few months while holding down other full- or part-time employment.

Despite these challenges -- most of which were anticipated at the outset -- valuable analysis and issue development were achieved. The recommendations contained in this report will result, if implemented, in real and significant savings and other benefits to American taxpayers whose hard work and personal sacrifices financially support these Federal programs and operations.

We believe that the majority of our recommendations are fully substantiated. However, it would be misleading to allege that each and every recommendation is rooted in a uniformly high level of research, analysis and substantiation. Various time limitations, business resources, and other constraints did not permit achievement of the desired uniformity objective.

We have evaluated, therefore, the "supportability" of the recommendations on their management merits and have grouped them into the following three categories.

- Category I -- Fully substantiated and defensible. Recommendations in this category are, in the opinion of the Task Force, convincing and deserving of prompt implementation.

- Category II -- Substantially documented and supportable. Recommendations in this category may not be fully rationalized or documented in the report, but all indications point to the desirability and defensibility of proceeding with their implementation.

o Category III -- Potentially justifiable and supportable. Recommendations in this category, while meritorious, are not regarded as fully supported in the report, due to time, personnel resources, and other constraints, but are deemed worthy of further analysis to determine the full extent of their merit.

These category descriptions do not take into account political, social or economic conditions which may alter the supportability of these recommendations for implementation. Accordingly, it is possible, by grouping the recommendations along the above categories, to assess more effectively the cost savings that can be expected. This analysis permits summary estimates of firm, probable and potential savings.

The Report Recommendations -- An Assessment

Based on the above perspective and categorization, an assessment of the reported recommendations is contained in the matrix on the following page.

	Issue/Recommendations	Three-Year Cost Savings (S)/Revenue (R)/ Cash Acceleration (CA) Opportunities 1/ ($ millions) Category I	Category II	Category III
R&D 1	Strategic Planning	$ 7,300.0 (S)		
R&D 2	R&D Management and the Budget Process	3,670.0 (S)		
R&D 3	Privatization	2/		
R&D 4	Management of Federal R&D Laboratories	506.4 (S)		
R&D 5	Administration of Research Grants to Universities	387.9 (S)		
R&D 6	Research Program Reporting	225.5 (S)		
R&D 7	NASA Cost Reporting	2/		
R&D 8	Compendium Issue	23,518.5 (S)	9,399.3 (S) 66.4 (R)	
	Total Savings (S) by Category	$35,608.3 (S)	$9,399.3 (S)	$ --
	Total Revenue (R) by Category	$ --	$ 66.4 (R)	$ --
	Grand Total Savings and Revenue	$35,608.3	$9,465.7	$ --

1/ Amounts in this summary cover three years, include inflation, and are net of implementation costs.

2/ Recommendation not quantified.

I. INTRODUCTION

I. INTRODUCTION

Federal Research and Development

Total research and development (R&D) in the United States is approaching the $80 billion level. As shown in Exhibit I-1, the funding level in 1982 was $77.3 billion with $74.6 billion coming from industry and Government in almost equal proportions (industry-funded, 49.8 percent; Government-funded, 46.7 percent). A substantial amount of the Government funding of R&D is transferred to industry ($17.8 billion) and universities ($6.95 billion) for the actual conduct of the R&D. Thus, while industry funded an estimated 49.8 percent of the national R&D effort in 1982, it performed 72.1 percent of the total R&D. Government, in contrast, funded 46.7 percent of the 1982 effort, but only performed 12.9 percent.

Federal Government efforts in R&D have three broad objectives:

- o to perform R&D for the Government's own use, i.e., to achieve the mission of the various Federal agencies;
- o to provide a strong science and technology base for the nation, its development and educational programs; and
- o to expedite commercial exploitation of technology and ensure a strong economy.

The Federal Government has two major responsibilities with respect to meeting national needs through R&D:

- o to provide a climate for technological innovation that encourages private sector R&D investment, and
- o to focus R&D support on areas with significant potential benefit to the nation, but where the private sector is unlikely to invest adequately.

[Exhibit I-1 on the following page]

Exhibit I-1

Intersectoral Transfers of Funds Used for Performance of Research and Development, 1982 (est., millions of dollars)

Sources of funds	Performers: Federal Government	Industry	Universities & Colleges*	Other nonprofits	Total	% distribution, sources
Federal Government	10,000	17,800	6,950	1,375	36,125	46.7
Industry		37,900	275	325	38,500	49.8
Universities & colleges			1,600		1,600	2.1
Other non-profits			475	585	1,060	1.4
Total	10,000	55,700	9,300	2,285	77,285	100.0
% distribution, performers	12.9	72.1	12.0	3.0	100.0	

* Includes university-affiliated, Federally Funded Research and Development Centers (FFRDCs).

SOURCE: National Science Foundation: "National Patterns of Science and Technology Indicators," 1982.

The Federal Government will spend approximately $44.3 billion for the conduct of R&D in FY 1983. 1/ Exhibit I-2, on the following page, shows the breakdown of that amount by principal agencies. The Department of Defense (DOD) accounted for more than half (56 percent) of the Government funding for R&D. The National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE) account for another 25.7 percent. The remainder of the R&D budget (18.3 percent) comes from the Department of Health and Human Services (HHS), the National Science Foundation (NSF), and the other agencies.

The Office of Science and Technology Policy (OSTP), established within the Executive Office of the President in 1976, is involved in overall Government R&D. This Office had a budget in FY 1983 of $1.84 million and 12 full-time permanent positions. OSTP's responsibilities include:

- advising the President on science and technology considerations related to the economy, national security, foreign relations, health, energy, environment, resources and other related matters;

- evaluating the Federal effort in science and technology and recommending appropriate action on it;

- advising the President on science and technology considerations in the Federal budget and working with the Office of Management and Budget (OMB) on the review and analysis of R&D items in the budgets of all Federal agencies; and

- assisting the President in coordinating the R&D programs of the Federal Government.

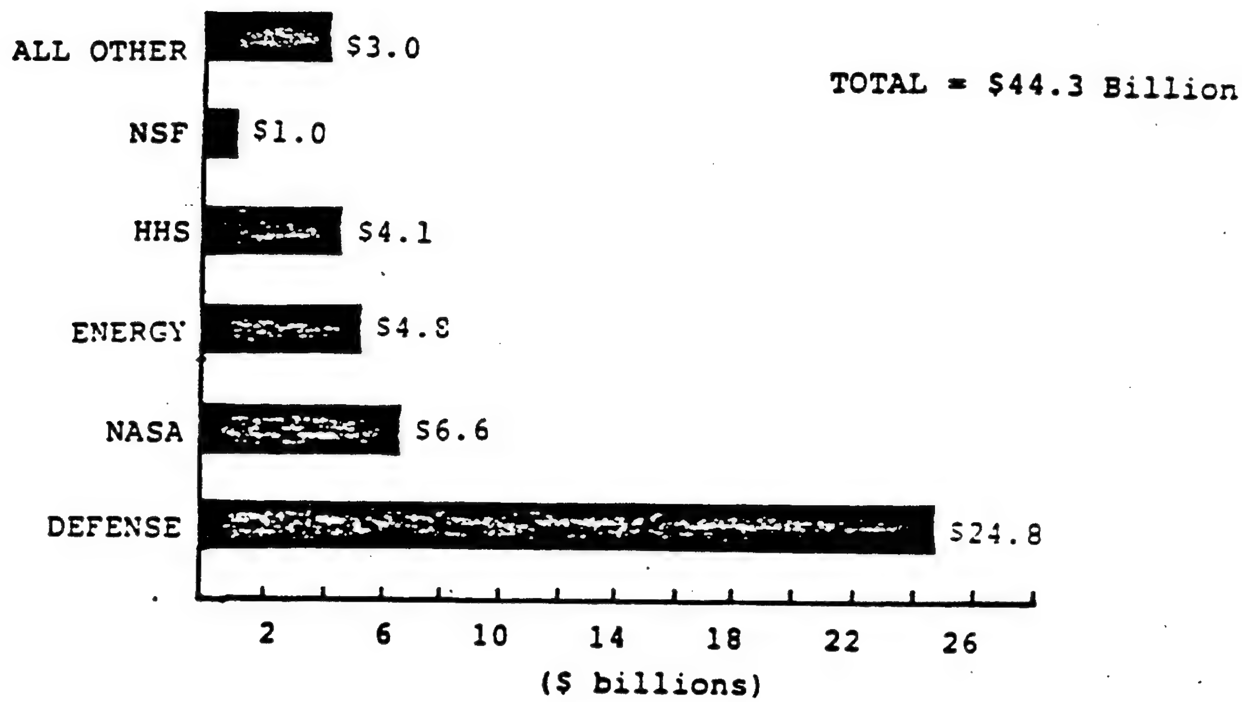
As such it is primarily involved in macro-policy matters and does not, in general, get actively involved in the direction of the individual R&D programs. Its primary concerns focus on the supply of engineering and scientific manpower to support technology development; cooperation between the basic research efforts of the Government, universities and industry; and the basic thrusts of overall science and technology efforts.

[Exhibit I-2 on the following page]

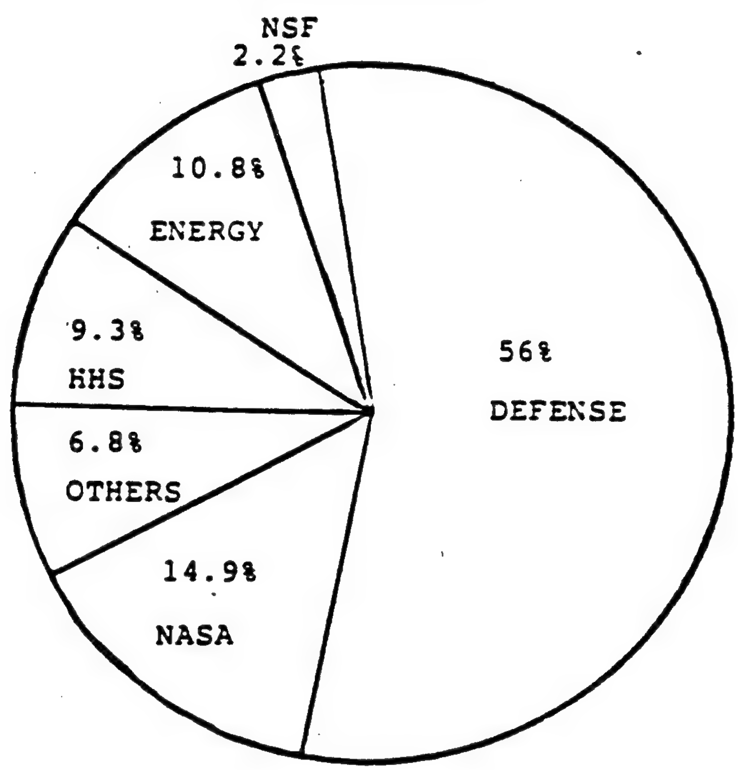
1/ The estimate of $44.3 billion for Federal R&D is derived from the official FY 1983 budget documents. This figure differs with the figure shown in Exhibit I-1 ($36,125 million), which came from an NSF publication (NSF Report 82-319). Although the discrepancies cannot be fully reconciled, they are probably due to definitional and reporting inconsistencies.

Exhibit I-2

TOTAL R&D BUDGET



% DISTRIBUTION



SOURCE: Office of Management and Budget, FY 1983 Budget.

The Government has more than 700 R&D laboratories under its auspices, employing more than 206,000 people. However, only 23.7 percent of all Federally funded R&D is conducted intramurally (within Government-owned and -operated laboratories). About 52 percent of Federally funded R&D is conducted by industrial firms. An additional 3.3 percent is conducted by industrial firms at Federally Funded Research and Development Centers. The remainder is performed by nonprofit institutions such as universities, by state and local governments, and by foreign researchers. Exhibit I-3, on the following page, presents the distribution of Federally funded R&D by performer.

Federal Government involvement in R&D spans the spectrum of scientific and social disciplines. Exhibit I-4 presents a breakdown of the Federal budget by basic and applied research categories. Research in the life sciences (e.g., biology) will receive more than $4.7 billion, or 35.7 percent of the total estimated budget of $13.3 billion for basic and applied research in FY 1983. About $3.2 billion, or 23.9 percent, will be spent for engineering research; research in the physical sciences (e.g., physics) will account for $2.8 billion, or 21.5 percent of the total budget. 2/

The following is a more detailed overview of each of the principal agencies expending R&D funds:

Department of Defense -- R&D funds for DOD are used to support the modernization of the national defense forces through the development of new strategic and tactical weapons and supporting systems. 3/ Nearly $25 billion (56 percent) of the total Federal R&D budget is obligated for Defense R&D (including test and evaluation) in FY 1983, representing a 19 percent increase over FY 1982. Funds are apportioned among DOD's three Services (Army, Air Force and Navy), nonaffiliated defense research agencies, and the director of test and evaluation. Approximately 46 percent ($11.4 billion) of Defense R&D is conducted or sponsored by the Air Force. Exhibit I-5 presents a breakdown of the Defense R&D budget by Service.

[Exhibits I-3, I-4 and I-5 on the following pages]

2/ National Science Foundation, Federal Funds for Research Development, Fiscal Years 1981, 1982 and 1983.

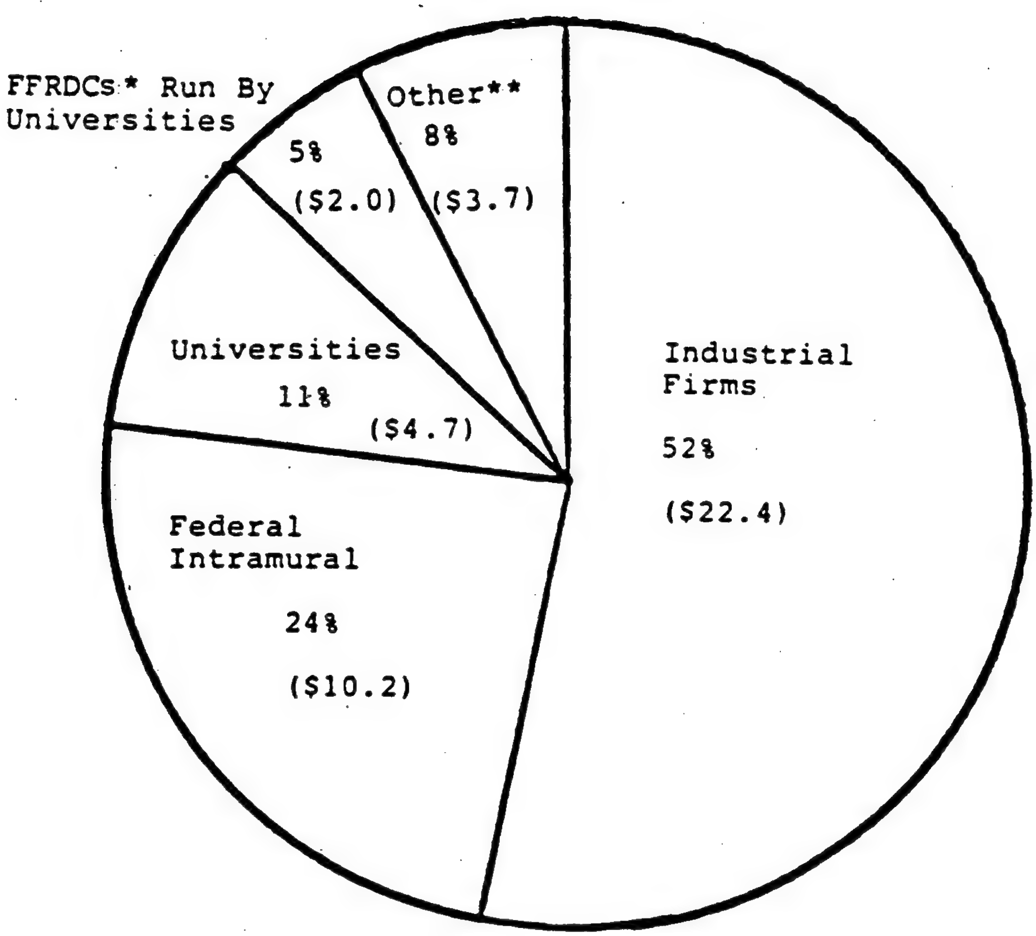
3/ President's Budget, FY 1984, Appendix.

Exhibit I-3

FEDERALLY FUNDED R&D BY PERFORMER,
FY 1983 (estimated)

($ billions)

Total = $43.0, Excluding $1.3 for R&D Facilities



Source: National Science Foundation, Federal Funds for Research and Development, Fiscal Years 1981, 1982 and 1983.

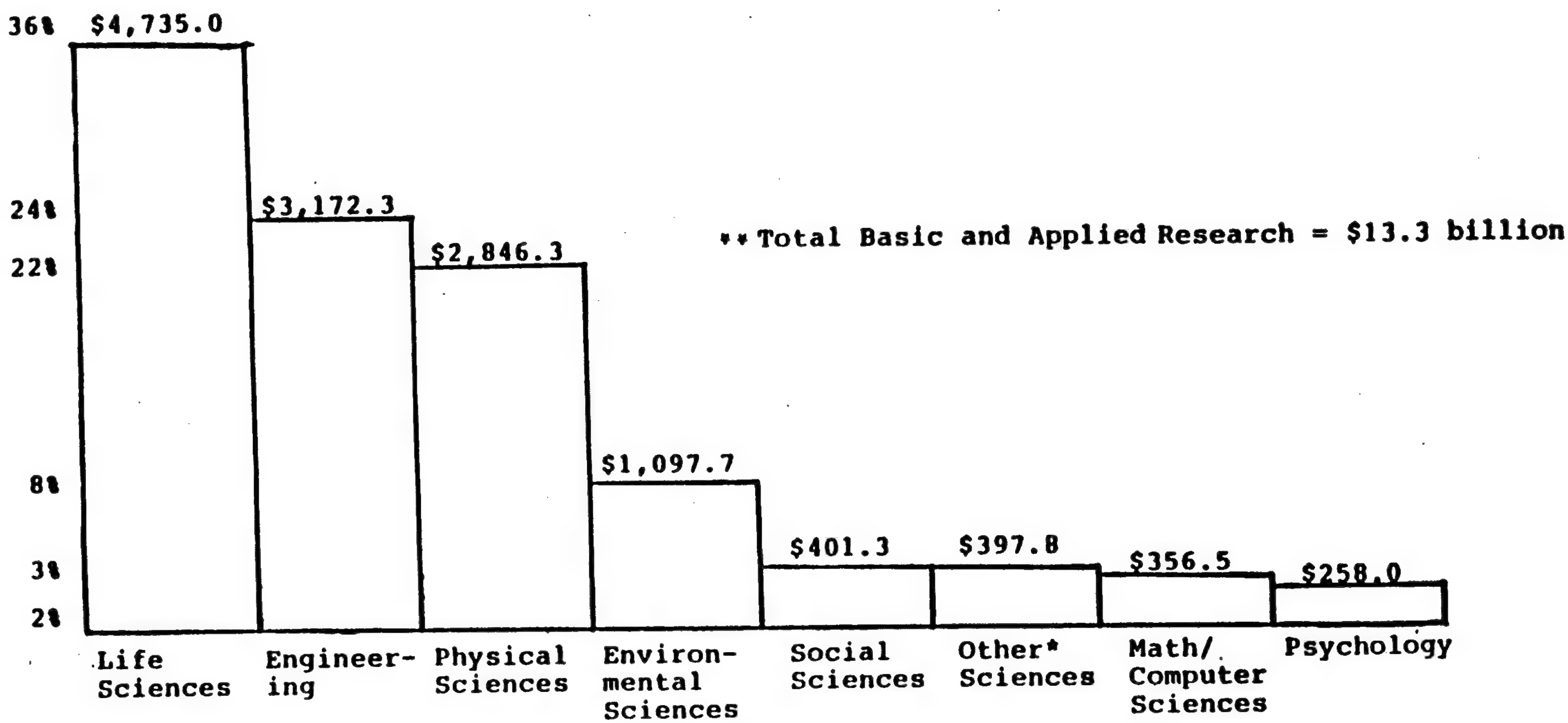
*Federally Funded Research and Development Centers (FFRDCs)

**Other:	FFRDCS Run by Industrial Firms	3.0%	($1.4)
	Other Non-Profit Institutions	3.0%	($1.2)
	FFRDCS Run by Non-Profit Institutions	1.0%	($0.6)
	Foreign Governments	0.6%	($0.3)
	State and Local Governments	0.4%	($0.2)

Exhibit I-4

FEDERAL OBLIGATIONS FOR BASIC AND APPLIED RESEARCH BY CATEGORY, FY 1983 (estimated)

($ millions)



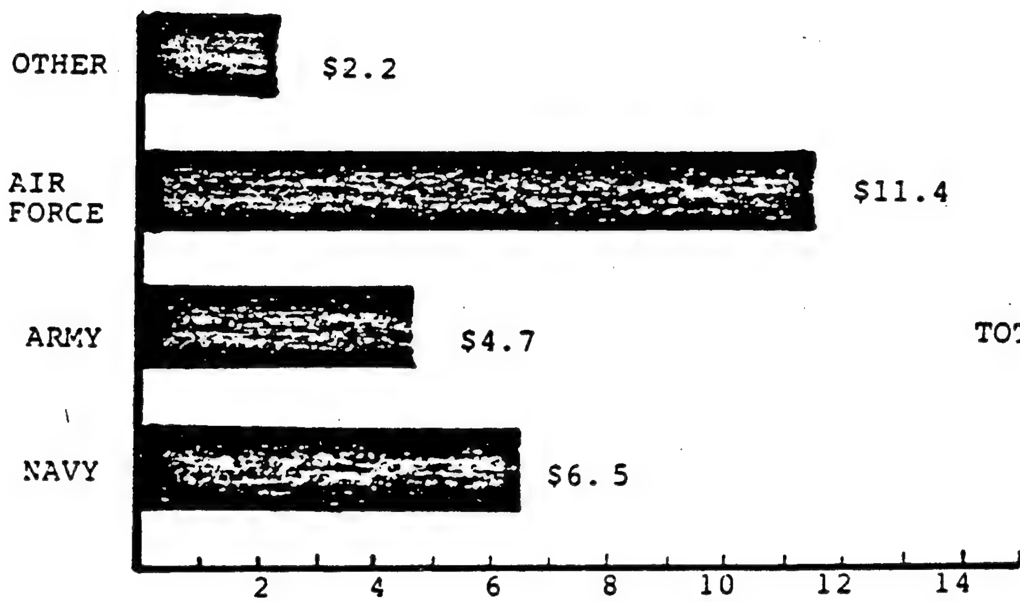
SOURCE: Op. Cit., National Science Foundation

*Not Elsewhere Classified

**Excludes $30 billion for development and R&D facilities

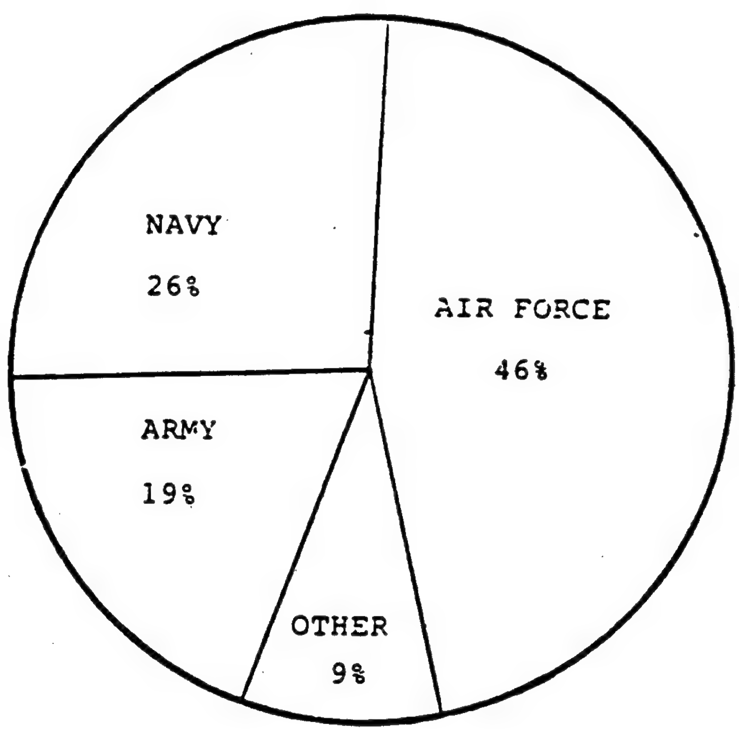
Exhibit I-5

DOD FY 1983 R&D BUDGET BY SERVICE
($ billions)



TOTAL = $24.8 Billion

% DISTRIBUTION



SOURCE: Office of Management and Budget, FY 1983 Budget.

Defense R&D program areas and FY 1983 budget obligations are as follows:

	($ millions)
Technology Base	$ 3,288
Advance Technology Development	928
Strategic Programs	6,520
Tactical Programs	7,524
Intelligence and Communications	2,675
Program Management and Support	2,849
Other Appropriations	685
R&D Facilities	366
Total obligations	$24,835

The R&D expenditures of DOD, in addition to providing for the defense of the country, have many impacts in the private sector. The work on the very high speed integrated circuits (VHSIC), which is included in several of these R&D categories, will have direct impacts on civilian technology products. In the past, the Government-funded B-52 R&D was in part responsible for the commercial Boeing 707 airplane.

National Aeronautics and Space Administration -- Government investment in R&D through NASA has the objective of yielding new space technologies to improve the long-term scientific and technological strength of the nation. Over $6.6 billion, or 14.9 percent of the Federal R&D budget, is obligated for FY 1983 to meet that objective. This represents about an 11 percent increase over FY 1982 obligations. Over 52 percent of NASA's R&D budget will go to the Space Transportation Systems (STS) program. The main components of that program are the development, testing and procurement of the Space Shuttle fleet and continued procurement of the second Space-lab. STS and other NASA R&D programs are funded as follows:

Program	($ millions) 1983 Estimate
Space transportation system	$ 3,468
Space science	682
Space and terrestrial applications	320
Aeronautical research and technology	232
Space research and technology	123
Energy technology	---
Tracking and data acquisition	509
Research and program management	1,179
Total conduct of R&D	$ 6,513
R&D facilities	116
Total obligations	$ 6,629

Department of Energy -- DOE R&D has the objectives of (a) developing new energy technologies, (b) improving existing technologies, and (c) developing a better understanding of high energy physics and nuclear sciences. About $4.8 billion, or 10.8 percent of the total Federal R&D budget, will go toward achieving these objectives. This includes $220 million for R&D sponsored by the Nuclear Regulatory Commission. 4/

Health and Human Services -- R&D funding for HHS in FY 1983 is projected at $4.1 billion, or 9.3 percent of the Federal R&D budget. This represents about a 3 percent increase over FY 1982 obligations. Over 85 percent of HHS R&D funds are obligated by the National Institutes of Health (NIH), which conducts R&D in the following areas:

- o life processes in health and disease,
- o clinical research,
- o antiviral drugs,
- o diabetes,
- o epidemiology, and
- o toxicology.

FY 1983 obligations by HHS major R&D activities are as follows:

Health:	($ millions)
National Institutes of Health	$ 3,533
Alcohol, Drug Abuse and Mental Health Administration	289
Food and Drug Administration	75
Centers for Disease Control	74
Health Care Financing Administration	30
Office of Assistant Secretary for Health	20
Health Services Administration	1
Special Foreign Currency Program	1
Subtotal	$ 4,023

4/ DOE R&D functions were proposed for transfer to the Department of Commerce (DOC) under the name of the Energy Research and Technology Administration (ERTA). This has not yet occurred. Therefore, DOE R&D figures in this Report include those attributed to the Department of Commerce, ERTA, in budget literature for FY 1983.

Human Services:

Office of Human Development Services	$ 59
Social Security Administration	25
Departmental Management	16
Subtotal	$ 100
Total conduct of R&D	$4,123
R&D facilities	$ 20
Total obligations	$4,143

National Science Foundation -- NSF's share of the FY 1983 R&D budget is $1.0 billion, or 2.2 percent of the total R&D budget, which represents a 7.5 percent increase over FY 1982.

NSF obligations are primarily used to support basic research in all scientific disciplines through grants to scientists and engineers associated with academic institutions. The NSF R&D objective is to complement basic research programs of agencies such as DOD and NIH.

Task Force Methodology

During its review of the Federal R&D process, the Task Force addressed seven major issues:

- Strategic Planning,
- R&D Management and Budget Process,
- Privatization,
- Management of Federal R&D Laboratories,
- Administration of Research Grants to Universities,
- Research Program Reporting, and
- NASA Cost Reporting.

These issues were selected for study because:

- They represent the largest potential cost savings of all issues surfaced.

- They require the highest level support to obtain resolution.

- They are fundamental or underlying causes of many problems identified but not resolved by past studies.

In addition to these seven issues, the Task Force prepared a compendium of R&D issues included in the other PPSS Task Force reports.

The nature and extent of the problems related to R&D management were substantiated during personal interviews with Presidential appointees and other key agency management personnel. Further information was gained by interviewing officials from OMB, the General Accounting Office, OSTP, and other selected sources.

A literature review of prior reports and past studies on the issue was also conducted. In all, 414 personal contacts were made and 104 significant past studies examined.

In reviewing Federal Government R&D, we contacted the major agencies including DOD, NASA, DOE, HHS (including NIH), NSF, Department of Agriculture, DOC, Department of Transportation, and the Environmental Protection Agency. Individual issues used the results of the data collected from subsets of these agencies. They are identified in the methodology sections of the appropriate issue.

Significant Contributions

We acknowledge the significant contributions of the Co-chairmen of the R&D Task Force: William Ballhaus (Beckman Instruments); Karl Bays (American Hospital Supply); James Ferguson (General Foods); David Packard (Hewlett-Packard); and Edson Spencer (Honeywell). These individuals devoted a good deal of time and personal attention to reviewing and guiding the study. We also acknowledge the significant contributions of the R&D Task Force members on temporary assignment in Washington, D.C. Our PPSS Management Field Officer O.T. Berkman and Desk Officer

Robert Pikul contributed thoughtful and helpful guidance. We had exceptional administrative support under the supervision of Linda Holt.

A number of persons in the various agencies were contacted and interviewed in the course of the Task Force's assessment of Federal R&D. The area of expertise and the perspective of those interviewed varied widely, as would be expected, but the spirit of cooperation and openness was universal and outstanding. Agency officials and staff provided data and supporting documentation that greatly assisted our efforts. Their attitude and support were critical to the success of the PPSS effort.

We specifically thank NASA for providing office space conducive to the Task Force work and NSF for assistance in gathering statistical data, references, and other information.

We would also like to acknowledge the time and contributions of private sector persons who helped validate our own private sector administrative model. We have listed these contributions in Section V.

II. ISSUE AND RECOMMENDATION SUMMARIES

II. ISSUE AND RECOMMENDATION SUMMARIES

RESEARCH AND DEVELOPMENT

R&D 1: STRATEGIC PLANNING

Issue and Savings

Can improvements in strategic planning, particularly in the goal-setting process, result in improved and more cost-effective research and development (R&D) management in the agencies?

The Task Force believes that significant improvements are possible in the R&D management process through the implementation of effective strategic planning. Implementation of specific recommendations would result in estimated savings of $2.2 billion in the first year, $2.4 billion in the second year, and $2.7 billion in the third year for total three-year savings of $7.3 billion.

Background

Strategic planning has evolved over the last 25 years into a valuable management tool, one that is necessary to set the overall direction for any organization and to provide the framework to guide both long-range and short-term actions. As shown in Exhibit II-1, on the following page, it is basically a system to:

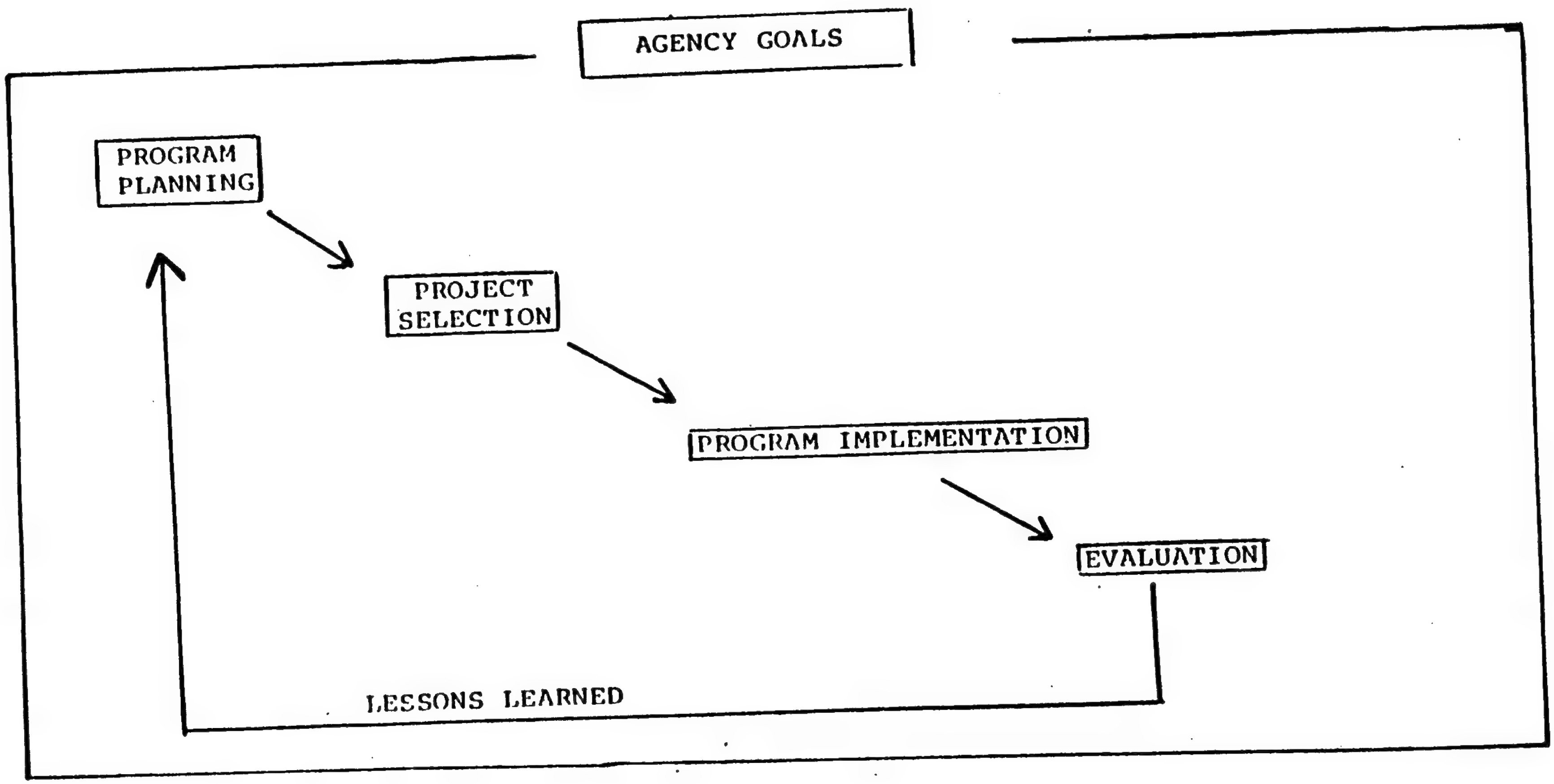
- articulate the agency goals;
- formulate and evaluate program plans for achieving the goals;
- select alternative projects within resource constraints;
- prepare and document implementation actions; and
- evaluate the programs.

Strategic planning must be evaluated as a process and as a substantive activity, particularly in the statement of goals. If the goals that come out of the process do not contain the necessary attributes, then the remainder of the

[Exhibit II-1 on the following page]

Exhibit II-1

STRATEGIC PLANNING



steps in the process of strategic planning are of limited value. It is increasingly recognized that the establishment of goals is one of the most difficult tasks involved in strategic planning. It is also apparent that in those situations where the goals were poorly defined, the results of the entire process were less than satisfactory.

In recent years, the private sector has increasingly emphasized and focused attention on the establishment of specific long-range goals. More and more large corporations are instituting formal long-range strategic planning processes. Most corporations start by analyzing economic conditions and their projected market posture for ten or 15 years into the future. This exercise helps executives set specific goals and establish program definitions, budgets, and schedules, emphasizing the required near-term actions. These plans are usually produced by an iterative process involving many management levels, then communicated to all managers and supervisors. Top management reviews the plans periodically and must concur in any changes. The plans are used to establish and maintain audit trails for progress evaluations.

The Task Force members are familiar with the R&D strategic planning processes used by the corporations represented on the Task Force and other well-managed industrial firms. Benefits of strategic planning must be very real because major corporations have continued to increase their planning emphasis, despite the many implementation problems that have been identified.

Within the Government, strategic planning received its first real emphasis in the early 1960s with the efforts of Secretary McNamara in the Department of Defense (DOD). Initial strategic planning efforts were made under the Planning, Programming and Budgeting System (PPBS). Since then, the name of the systems and the emphasis have changed, but some of the elements of the strategic planning process are in place in most agencies. The elements currently used include:

- o definition of goals (sometimes called missions or objectives);
- o analysis of requirements and constraints;
- o identification of alternatives;
- o analysis of alternatives;

- comparison of alternative to resources;
- selection of alternative;
- definition of implementing actions;
- consolidation and review; and
- documentation.

This issue will address both the key substantive point of strategic planning (the definition of goals) and the process of strategic planning.

Methodology

The following approach was taken to develop the findings and validate the conclusions reached. The Task Force:

- determined current agency practices by review of the literature, assessment of current practices, and interviews with senior agency management;
- analyzed previous studies in related areas and discussed them with agency management; and
- assessed comparable industry practices and experience.

Prior to discussions with Federal agencies regarding strategic planning techniques, Task Force personnel performed a review of business publications on the subject, compared techniques used by major industrial firms, and reviewed prior studies performed on planning problems for the technology base within several Federal agencies.

Since it would have taken many months of effort on the part of this team to review all agencies with R&D budgets, the Task Force decided to concentrate its efforts for this issue on three Federal agencies: DOD, the National Aeronautics and Space Administration (NASA), and the Department of Energy (DOE). These three agencies are presently budgeted for $36.2 billion, which represents 82 percent of the total FY 1983 R&D budget. Further, as DOD spends 56 percent of these funds, the Task Force emphasized its R&D involvement. We did, however, briefly consider the National Institutes of Health (NIH) and the Department of Agriculture (USDA).

Although the team's efforts were concentrated on the three agencies, there is every reason to believe that the findings are typical of all agencies. Any benefits that could be derived from implementation of recommendations contained in this Report could be similarly achieved by the other agencies.

Findings

Based on the experience in our own corporations and on knowledge of other corporations in the private sector, the Task Force believes that the Government is five to ten years behind industry in strategic planning. There appears to be limited long-range strategic planning in Government agencies. Although a number of agencies have partially developed elements of the strategic planning process, none of these elements are based on specific Federal goals.

In describing our findings on strategic planning in the principal R&D agencies in the Federal Government, we have made a distinction between the statements of goals used in the planning process and the process itself. In some cases, strategic planning is based on goal statements that are so broad and general that they minimize the benefits that can be derived from the process. In other cases, where goals have been well defined, strategic planning can be a valuable tool.

Our analysis of strategic planning starts with an assessment of the existing statements of goals. This is then followed by an assessment of the strategic planning process itself. The section concludes with several findings dealing with the results of existing planning processes.

1. Lack of Consensus on Goals

The absence of full agreement on Federal goals causes confusion within the agencies and forces them to create their own goals. This is the greatest problem the Task Force found in current strategic planning efforts.

DOD serves as a clear illustration. The three Services (Army, Navy, and Air Force) plan almost autonomously and frequently at cross purposes with little direction provided by the Under Secretary of Defense for Research and Engineering (USDRE) or the Office of the Secretary of Defense (OSD). There are relatively few joint programs between the Services, even though their tactical requirements often demand essentially the same R&D. In NASA and DOE, the absence of Federal goals has led to disarray in setting priorities and to "bootlegging" pet projects.

In order to be more specific about the problems with existing Federal goals, the Task Force put together a set of criteria to be used in evaluating the usefulness of goals for strategic planning purposes. In developing these criteria, the Task Force relied on the experience in their own corporations and the general literature available.

- A good goal is a clear, measurable, specific statement of what is to be accomplished (for example, "reduce the nation's infant mortality rate by two percent over the next five years").

- A time frame is stated ("improve communications and control systems in the next eight years to make sure we can communicate with strategic forces, even after a nuclear attack").

- The group responsible for implementation is designated ("to be carried out by the Chief of Naval Operations").

- Projected results of achieving the goal are perceived by the public, by employees and by others to be worthwhile (e.g., successful completion of a magnetic fusion demonstration plan would provide the nation with a safe, renewable, inexpensive source of energy).

- The goal is feasible (e.g., "put a man on the moon by the end of the decade").

If goals do not meet these criteria, then there will be little or no guidance in the design of alternatives; their analysis, ranking and selection; and the identification of implementing actions. A goal for NIH to "reduce the nation's infant mortality rate by 2 percent over the next five years" provides real guidance and direction to strategic planning. In contrast, a goal to "solve the nations's energy problems" provides little, if any, help to the subsequent steps.

Using the criteria defined above, the Task Force analyzed the content of some of the more prominent Federal goals.

Strategic Program for Defense -- The Strategic Program for Defense provides an example of a goal developed in extensive consultation between the White House and DOD, and then articulated by the President. It is a comprehensive plan for revitalizing our strategic deterrent which will end the relative decline of U.S. strategic capabilities and put the

United States in a position to reshape the U.S.-Soviet strategic competition in the eight years ahead. It deals with one specific area of national defense and embodies all of the basic characteristics of an effective goal. It outlines in detail in which direction the President wants to lead the nation in five strategic areas. It specifies a time frame for achieving results. The responsible party is clearly DOD. Further, it is perceived to be worthwhile in enhancing the defense posture of the United States. It is feasible and can be accomplished in the time period specified. It is acceptable to DOD, Congress, and the public.

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
Strategic Program for Defense	Yes	Yes	Yes	Yes	Yes

National Space Policy -- The R&D goals of NASA are to extend our knowledge of the earth, its space environment and the universe; to expand space technology for practical applications; to develop, operate, and improve manned and unmanned space vehicles; to provide technology for improving the performance of aeronautical vehicles; and to assure continued development of the aeronautics and space technology necessary to accomplish national goals. These national goals articulated by President Reagan are:

- to strengthen the security of the United States;
- to maintain United States space leadership;
- to obtain economic and scientific benefits through the exploitation of space;
- to expand United States private sector investment and involvement in civilian space and space-related activities;
- to promote international cooperative activities in the national interest; and

o to cooperate with other nations in order to maintain the freedom of space for activities which enhance the security and welfare of mankind.

NASA's mission statement is too general to be considered much more than public relations, and the President's space policy is not much more specific.

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
National Space Policy	No	No	Yes	Maybe	Maybe

NASA's goal is incomplete compared to the five industry attributes of a well-articulated goal. Goal ambiguity forces NASA to fill in the gaps on its own. As a result, the agency's planning process suffers from the lack of top-down guidance.

National Heart, Lung and Blood Institute (NHLBI) -- The mission of NHLBI, "... to advance the national attack against diseases of the heart and blood vessels, the lungs and blood ..." also does not meet the industry criteria.

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
NHLBI	No	No	Yes	Yes	Maybe

The issue team recognizes that setting specific goals for basic research is more difficult than for applied research. Efforts should be made to be as specific as possible, but strict adherence to demands of timing or feasibility may be unrealistic. Again, nebulous goals are hampering a good planning process.

Energy -- National goals for energy development are in shambles. This is understandable in light of:

o oil embargoes and instability in the Middle East;

- the distinct lack of public confidence in nuclear energy, prompted by the Three Mile Island crisis and the nuclear waste disposal question;

- DOE's tentative future;

- the shift in policy to allow the marketplace to guide the development of energy systems; and

- public disillusionment with expenditures on alternative energy technologies, i.e., their failure to provide commercially viable energy production systems.

The issue team believes this is a prime example of an area where it is difficult to develop meaningful goals; by the same token, it is urgent that specific energy goals be developed.

The Task Force reviewed two statements of goals in the energy area: The National Energy Policy Plan and the much more specific Magnetic Fusion Energy Program. The National Energy Policy Plan, submitted by President Reagan to Congress to meet the requirements of the Department of Energy Organization Act (PL 95-91), is a broad statement of the Administration's energy policy. The issue team did not find adequate guidance in the 1981 statement (the latest available at this time) for DOE management. As a broad policy document it did not articulate clear, measurable and specific goals which were to be met in a stated time frame.

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
National Energy Policy Plan	No	No	Yes	Yes	No

In contrast, The Magnetic Fusion Energy Engineering Act of 1980 (P.L. 96-386) provides national goals for demonstrating the scientific and engineering feasibility of the use of fusion energy. By industry standards, this is a fairly complete goal.

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
Magnetic Energy Fusion Program	Yes	Yes	Yes	Yes	Maybe

Some experts, however, question the scientific and commercial feasibility of this goal.

Summary -- In setting goals, an effort must be made to prevent political considerations and "wishful thinking" from biasing or overriding technical analysis. This may or may not have happened in the energy goal-setting process. There will always be some doubt about a goal's feasibility. The issue team emphasizes this doubt because it is commonly voiced during any good goal-setting process. Decision-makers worry that despite good analysis, the goal cannot be met. There is no way to avoid the doubt. Therefore, goal-setting must be an ongoing process, where progress and feasibility are constantly reevaluated.

The issue team found elements at work in each of the agencies, but none has a complete set (see Exhibit II-2, Summary Table, on the following page). The clarity and content of the actual goals simply do not meet the industry standard. There is little evidence of top-down, bottom-up consultation combined with staff analysis. None of the agencies has a complete set of clearly defined Federal goals. The absence of goals severely hampers the ability of existing planning processes to produce results. Typically, the agencies attempt to cover as many areas as possible rather than targeting R&D to top national priorities. This approach tends to allow R&D projects to proliferate when many of them should be terminated. All of the PPSS Task Force reports dealing with weapon systems development and procurement (OSD, Air Force, Navy and Procurement) found, for example, that DOD suffers from an inability to prioritize its weapon systems projects.

[Exhibit II-2 on following page]

EXHIBIT II-2

SUMMARY TABLE: Five Federal Goals Compared to Basic Industry Criteria For Establishing Effective Goals

	Clear Measurable Specific	Stated Time Frame	Responsible Group Designated	Results Worth-while	Feasible Goal
Strategic Program for Defense	Yes	Yes	Yes	Yes	Yes
National Space Policy	No	No	Yes	Maybe	Maybe
NHLBI	No	No	Yes	Yes	Maybe
National Energy Policy Plan	No	No	Yes	Yes	No
Magnetic Fusion Energy	Yes	Yes	Yes	Yes	Maybe

2. Most Agencies Use Key Elements of the Strategic Planning Process

Most of the Federal agencies utilize some of the key elements of strategic planning. In some cases, they do not receive the emphasis they should because they are dominated by the annual budget process. In other cases, their effectiveness is severely hampered by the inadequacies in the goal statements cited above. The following paragraphs briefly evaluate the process used in the major agencies.

Department of Defense (DOD) -- At present overall DOD planning as well as R&D strategic planning is highly fragmented. Each Service has developed its own independent planning techniques, and each essentially competes for budget funding. Very few joint programs are underway, and the role of USDRE is minimal due to the fact that it has no authority for overall R&D programs within the Services, other than veto power. It would be difficult to establish a strategic plan for DOD R&D unless either OSD or USDRE directly manages the three Services, as well as other agencies within DOD such as the Defense Advanced Research Project Agency (DARPA). At present, the three Services operate very different R&D planning processes, as described below.

- Air Force -- The Air Force has developed and is using a formal planning process called Vanguard. It requires that each planner identify the jobs that must be done and assess the Air Force capabilities to perform those jobs with current forces and currently programmed improvements. The planning system is designed to identify potential deficiencies, planned modifications, and comparison with budget constraints. The Vanguard plans are prepared as briefings. When properly used, the plan will provide answers to such questions as: (a) How does a program element contribute to meeting Air Force military needs? (b) What is the contribution of a program to other mission areas? (c) What is the effect of cancellation or delay? (d) Does it fit the budget? (e) What are the key decision points and when do they occur? (f) Is the new system compatible with existing programs?

  A technology plan links basic research and exploratory development programs to decisions provided by other plans, thus providing guidance to the laboratories. The Vanguard planning process is in its early stages of implementation and has not been in place long enough to produce any notable improvements.

There is little or no coordination of programs among the other Services of OSD included in this planning process. One of the purposes of the Vanguard plan is to project needs of the Air Force for the next 15 years. Accordingly, the plan should encompass joint efforts among the Services and be integrated with their long-range planning documents. For example, the Army Air Land 2000 and the Air Force 2000 programs are the long-range plans designed to project military needs in the next few decades. Yet there appears to be little coordination between the two Services at the most critical phase, the planning process.

- Army -- The Army planning process is identified in the U.S. Army Chief of Staff Regulation (CSR) No. 11-15, "Army Programs, Army Long-Range Planning System," issued in May 1981. This directs a look "ten to 20 years in the future." The Army recognizes that its planning is structured along program lines (e.g., tactical programs) and has a draft CSR in process titled, "Army Long-Range Research Development and Acquisition Planning." This will become a functional part of the Army long-range planning system described in CSR 11-15. The science and technology plan developed by this process is being issued for the first time in final form (the draft was issued two years ago), as is the first draft of the development and acquisition plan.

  Our assessment is that the Army's long-range planning process, as it is being developed for R&D, features all of the basic elements for effective strategic planning. It has the potential of becoming a system for all agencies, not just the Army. The Army agrees that it may take several years to implement and will require the continued attention of Army management from the Chief of Staff through all commands. Like the Air Force, the Army has little or no joint planning efforts with other Services or with OSD.

- Navy -- After extensive discussions with a cross-section of naval R&D management, the issue team found little evidence of a formal, comprehensive long-range planning process for the Navy. It did, however, uncover the initiation of a planning process in Office of Naval Research (ONR). The team reviewed several internal documents issued by the Chief of Naval Research in January 1982, pertinent points of which are summarized below:

- The policy guidance states that "the Naval R&D programs must display characteristics of technical excellence, direction, and emphasis which reflect a clear commitment to the Department needs and priorities."

- "The claimants (program originators) are expected to tailor their projects so as to complement (as opposed to compete with) the programs of DARPA, the other Services, national laboratories, industry and the universities."

- "Claimants are to consider the key naval needs in the formulation of their project proposals and will be required to include an assessment of the relationship of these needs to their proposal."

The issue team saw little evidence from the Navy that a strategic long-range plan was in development. The Service appears to be bogged down with bureaucratic policies and directives; it is not developing a set of goals from which an efficient, mission-directed research program can be derived.

<u>National Aeronautics and Space Administration</u> -- Strategic planning in NASA was developed in the 1960s to support the national goal stated by President Kennedy to put a man on the moon within the decade. That goal statement met the criteria previously identified. Since then, although there have been various statements of NASA's goals, they do not meet the criteria. Because of these inadequacies, recent efforts in strategic planning and the ranking of alternatives toward these goals result in frequent changes in program direction, often derived from political pressure and causing additional wasted expenditures. For example, several politically motivated Congressional directives regarding the type of booster to be utilized in the Galileo program have resulted in more than $100 million of additional expenditures.

Planning, coordination and control of NASA programs are performed at NASA headquarters; the technology centers are responsible for execution. NASA generates a long-range plan that lists details of desired programs. It is apparent from these lists that the majority of project planning and ranking is from the bottom-up rather than top-down, with each center administrator justifying his/her existence and facility.

Department of Energy -- Like NASA, DOE suffers from indirection. Long-range plans are assembled within the Department, but the ranking of alternatives is meaningless without clearly defined goals. As a result, the DOE long-range plan consists primarily of bottom-up project plans. Without adequate goals, DOE is subject to a high degree of micro-management from Congress and lobbying groups.

The issue team saw evidence that DOE managers scrutinize R&D programs and may even drop them if they do not fit their de facto goals. The team also observed that some expensive programs are "forced" on DOE by Congress (for example, the funding of insulation to be added to homes of the poor, which is clearly not a DOE mission). DOE was the only agency evaluated where agency officials stated that their own R&D budget should be reduced (and it was) rather than expanded.

The National Institutes of Health -- In the health arena, the Government primarily supports basic research. Most of this support is through NIH. In health, the Government is not the primary end-user (unlike defense or space) and, for the most part, leaves the application of basic research to the private sector. Thus, the task of strategic planning in health research is more difficult. The NHLBI provides a good example of this process at work.

NHLBI goals are articulated in the 1972 law that established the Institute. Specifically, NHLBI is " . . . to advance the national attack against diseases of the heart and blood vessels, the lungs and blood . . . ." In the absence of more specific goals, NHLBI develops its own. The NHLBI strategic planning process involves an annual update cycle characterized by a continuous flow of information from the public, the biomedical research community, the medical community, other Federal agencies and organizations outside of Government.

As part of this planning process, a series of reports and formal plans are published each year. These documents are prepared by NHLBI staff members to structure and coordinate input from the NHLBI Advisory Council and from committees and consultants. The documents serve as resource materials, implementation plans for program activities, and state-of-the-art assessments. They define program component interrelationships, inform Congress and the Administration of needs for accomplishing the five-year plan, and inform the scientific community about the Institute's accomplishments.

Department of Agriculture -- USDA is in the early stages of developing a strategic plan. The program strategy describes the kind of research that Agricultural Research Service (ARS) scientists identified as necessary to meet the short- and long-term needs of the agricultural sector. In addition, a six-year implementation strategy is being developed to provide guidelines for executing those portions of the plan that ARS believes have a high probability of attaining the stated research objectives. The guidelines seek to assure the most efficient use of available resources in pursuit of the objectives.

These plans are designed to achieve the following ARS goal:

> Through fundamental and applied research, ARS seeks to provide the means to solve the technical food and agricultural problems of broad scope and high national priority as required to assure perpetually an adequate supply of high quality food and fiber for the American people and for export.

The issue team concludes that the elements of this plan closely correspond to elements found in the private sector and will address many of the problems of ranking fundamental research programs. In the absence of more defined Federal goals, the plan outlines key research efforts based upon estimating future demands for food and other agricultural products. The issue team views this plan as potentially one of the best bottom-up processes reviewed within Federal agencies.

3. Evidence of the Inadequacies of Strategic Planning

In the private sector, the strategic plan is the driving force in establishing policy and setting priorities. Because of the lack of adequate goals and the inadequacies of the plans themselves, policy and funding priorities are deferred to the annual budget cycle in the Government.

Ultimately the final program selection is negotiated with the Office of Management and Budget (OMB), whose major interest is control of total budget dollars (rather than balancing national priorities). The annual budget cycle becomes a trade-off between competing laboratories and agencies. Rather than a debate between defined national priorities, the process is a series of negotiations determining how much increase (or decrease) in funding each agency must plan for the fiscal year. Sometimes agencies receive

funds they did not request, causing a last-minute rejuggling of their own priorities. Other times, some deserving programs are dropped in favor of a Congressionally supported program stemming from lobbying pressures. A set of defined long-range goals (five to 15 years) for each agency would provide agency management with a stronger mandate to minimize this type of redirection and simplify the planning process for individual agencies, as well as for Congress and OMB.

It is extremely important in R&D planning to achieve a balance between top-down planning and a bottom-up approach. In any Government agency, an absence of the top-down approach permits the bottom-up approach to predominate. This results in unnecessary program duplication between laboratories and agencies and tends to continue programs of marginal value because champions have successfully "sold" them. Some fundamental research projects that are not mission oriented should, of course, be budgeted to encourage creativity and potential spinoff. The majority of R&D programs, however, should be oriented toward defined agency goals, not pet projects. Again, the problem is the absence of formal, top-down guidance regarding the agency's goals that can be translated into requirements, both near and long term.

Present planning techniques often do not include implementation plans and scheduled decision points (milestones), making it difficult to determine progress and make course corrections from prior plans. Without defined strategic planning elements, these key milestones do not exist. Long-range planning should highlight program milestones and provide the needed visibility to minimize the "budget ax" or program redirections that often occur during budget cycles. R&D programs are rarely completed in one year. The annual reviews would be more meaningful if progress could be measured against a projected set of milestones and expenditures.

DOD has no central planning focus. The isolated planning techniques in the Services tend to muddy the planning focus at OSD; OSD exhibits little control of joint programs and does not provide encouragement for cross-fertilization of R&D and weapon systems. USDRE does not exercise leadership in DOD's goal-setting and planning process; there are very few joint Service R&D programs and little cross-fertilization. In fact, the issue team found that USDRE is encouraging greater decentralization. The Air Force, for example, has moved the direction of its many laboratories from a single management point to individual user commands. The issue team

members believe that such a step only serves to narrow the planning focus and make cross-fertilization even more difficult and duplication of effort more prevalent.

The degree of isolation is evident by the following:

- o Some military Service R&D managers do not even know who their counterparts are in the other military Services.

- o Programs within DARPA are not disseminated routinely to the Services.

- o Cross-fertilization is rare.

The majority of the longer-range planning done within Federal agencies is not constraint driven. For the most part, agencies employ a bottom-up planning approach and a broad set of agency goals, resulting in a process that forces agency planners to cover all potential contingencies. There is little ranking of issues at each level of the organization to assure that the real issues emerge and are analyzed in light of budget targets. This approach also forces the organization into a "selling mode" early in the process, a hazardous condition and one hard to change as the process rises to senior management.

The planning process fundamentally operates annually; almost all decisions are reviewed and re-reviewed and, indeed, many change from year to year. External pressure from Congress, frequent changes in policy and leaders, and failure of the system to provide a longer term strategic focus cause this kind of short-sightedness. Year-to-year planning is wasteful, particularly for R&D activities that tend to be long term. An enormous amount of time and dollars is eaten up in rejustifying each year's decisions. Agencies can avoid the important issues, since one year's unapproved program can be resubmitted the following year.

4. Implementation of Effective Strategic Planning Should Be Expected To Be Lengthy

Implementation of effective strategic planning in the Government R&D agencies is going to take time. Industry experience seems to indicate that agencies will need a three- to five-year learning process to evolve, refine, communicate, gain acceptance for and achieve a reasonably satisfactory degree of efficiency with respect to strategic planning. Top

management must persistently emphasize and support the process if there is to be any hope of success. Even then, according to industry experience, the process of setting goals and strategic planning is a never-ending discipline that must be maintained and continuously improved in order to produce results.

It is not surprising, then, that Government agencies attempting to incorporate long-range strategic planning are experiencing the same frustrations of the learning process. The U.S. Army started to develop its process four to five years ago. The first long-range plan for science and technology only just recently entered the system in draft form. This year's revision to the Army's Science and Technology plan is in final form now and a long-range strategic plan for Development and Acquisition is in draft form. The progress is real, and the Army should be commended and encouraged. Similarly, the Air Force Vanguard program is now being implemented and should produce measurable results by the next fiscal year.

Conclusions

Strategic planning as applied to Government R&D efforts is generally ineffectual in large part because the goals that have been established are not adequate to guide the planning process. Also the process does not work within realistic budget constraints and does not result in implementation plans that clearly spell out actions necessary to meet the goals.

These shortcomings cause the following deficiencies in R&D planning:

- Federal R&D plans do not direct available resources to areas with achievable results.
- Many more R&D programs are initiated than can be funded at either the development or acquisition stage.
- R&D programs are not ranked, which leads to inefficient use of development funds.
- Agency managers often are not able to terminate programs that do not meet cost and performance targets or that are no longer required to meet the mission and goals of the agency.

- There is much program duplication because of lack of cross-fertilization between laboratories, the Services, agencies and users.

- In the absence of formal, top-down guidance on the nation's priorities, Federal R&D programs cannot be effectively translated to meet both the near- and far-term technological requirements.

These deficiencies are identified in several other PPSS Task Force reports. Several of the reports dealing with defense issues pointed to the problem of initiating more R&D programs than can be funded and to problems of priorities. The PPSS Task Force Report on DOE highlights the duplications and problems in the R&D programs because of a lack of clearly articulated goals. In the Report on the Department of Transportation, the Task Force questions the lack of specific focus for that agency's R&D program.

Recommendations

R&D 1-1: Redirect all agency planning efforts to concentrate on developing statements of goals that reflect national and agency priorities. The lack of precision and clarity that exists in current statements of agency and program goals has been documented by the Task Force. Improvements in strategic planning require a major effort on the part of all participants in redefining the goals so that strategic planning can play the essential role that it should.

Goal setting is a discipline, not a sporadic chore. The process, as well as the goals themselves, require constant examination and emphasis. Top management cannot develop goals separately from the line managers and staff responsible for strategy and implementation. Similarly, line managers cannot focus adequate resources to achieve long-range goals they set by themselves. They need top management's concurrence and authority; a top-down, bottom-up mix of management participation is required. A continuous intensive process of this kind is typical of what is sought in the private sector.

In order to develop goals for the Government R&D programs, all levels of the organization must be involved, including OMB, the Office of Science and Technology Policy (OSTP) and the White House staff. The Findings section pointed to the goals for the Strategic Defense Program as the kind of goal statements necessary to guide and direct strategic planning. In order to improve R&D planning the same type of effort will be required in all areas.

The Task Force fully recognizes that the establishment of goals of the type described here is an evolutionary process that cannot be accomplished in a given time frame. In fact it will be a continuing process. Furthermore, it will not be possible to develop adequate goals for all aspects of Government R&D in a year or two. However, we recommend that the agencies initiate the process and develop the discipline necessary to influence strategic planning. Thought and interaction among all levels of the line and staff organization are the essential ingredients.

In order to institutionalize the goal-setting process, we recommend that each agency designate a senior official (at the Assistant Secretary level) to lead the internal effort and to coordinate with other agencies and the Executive Office of the President (EOP) through the Office of Science and Technology Policy (OSTP). Each agency should work with the appropriate Cabinet Council or the National Security Council in establishing the goals for the agency and reviewing the results of the strategic planning process. We recommend that OSTP coordinate the process and provide the necessary assistance in evaluating the adequacy of the goals. In the past, efforts to institutionalize strategic planning have focused on OMB and the associated budget process. This has not been very successful. The success of strategic planning is ultimately related to the commitment of top management. As this management changes, the new managers must assume the leadership role.

<u>R&D 1-2: Develop improved strategic planning concepts and procedures</u>. The Task Force has commented on many of the existing strategic planning systems and procedures. Each agency will require revisions to certain aspects of its systems.

Given the diversity of R&D missions and programs of the agencies we do not feel that a single system can be applied uniformly to all agencies. However, the system developed in each agency should provide for the essential element of strategic planning.

We recommend that each agency adopt a strategic planning process that will meet its needs. The senior official designated to lead the goal-setting effort should coordinate the development of the strategic planning process in the agency. Coordination with other agencies that appear to have effective systems (e.g., the Army and ARS) would be beneficial. However, the organizational and management style of each agency will influence the systems and procedures used.

R&D 1-3: Use strategic planning as the basis for subsequent budgeting and operational management. As the strategic planning process develops and encompasses certain agency activities, those portions of an agency's operations should be driven by it.

Too many strategic planning efforts have failed because they are subjected to rigid timetables. In such cases, the quality of the strategic planning is inadequate to support the budgeting and operational management. Artificial deadlines lead to inadequate analysis and procedural solutions.

We recommend that the agencies initiate the process immediately and begin the cut-over to budgeting and operational management as the quality of strategic planning permits. For example, we would not be surprised if it took more than five years of concentrated effort to develop an adequate strategic planning process in DOD. Any attempts to tie budgeting and operational management to the strategic plans before then would be counterproductive.

We recommend that each agency set its own pace in implementing strategic planning and that the pace be controlled by the top management of the agency. To ensure that progress is made, the agency should make a commitment to EOP regarding an implementation schedule.

Savings and Impact Analysis

It is difficult to quantify the dollar impact of effective long-range strategic planning. The primary thrust of our recommendations is improved management of the R&D process. Improved management focuses on the effectiveness of the process, not just the cost of conducting the program. The actual savings to be realized are open to debate. Although opinions vary, almost everyone agrees that real savings will result from incorporating long-range strategic planning into R&D operations. From industry's perspective, the process is essential.

One measure of the potential savings in the area can be seen from the PPSS Task Force on OSD. Issue OSD 21 recommended that DOD limit the number of new weapons systems starts based on anticipated funding availability (An effective strategic planning process would achieve this objective.). That Task Force estimated annual savings of $1.1 billion in Research, Development, Test and Evaluation (RDT&E) funds when the recommendations were fully implemented. If these figures were extrapolated to the total R&D budget of the Federal Government (on the basis of total R&D of $44.3

billion versus DOD's R&D of $24.8 billion), the annual savings when fully implemented would be $1.96 billion.

Elimination of R&D starts based on funding availability would be only one aspect of the savings which could be attributed to the implementation of our recommendations in this area. The improved effectiveness of R&D, the ability to more easily eliminate redundant research, and the ability to eliminate programs that do not meet cost and performance standards would add to anticipated savings.

Another approach to estimating potential savings was based on using three sources to develop an estimate of the degree of improvement and potential cost savings that could be expected with the implementation of an effective strategic planning system. These were:

- agency management personnel,
- public interest leaders, and
- senior private sector R&D managers, particularly the Co-chairmen of this Task Force.

It is the Task Force's collective judgment that 10 percent enhanced efficiency is a reasonable estimate. The leaders of several public interest organizations suggested numbers in the 10 to 20 percent range and the estimate of agency management personnel who would cite a figure was in the 10 to 15 percent range.

Accordingly, the Task Force conservatively estimates that the implementation of a strategic planning process would reduce overall R&D costs by 10 percent. However, in view of the complexity of this issue and of the many uncertainties involved, the Task Force recommends half of the claimed savings (5 percent) be viewed as an objective and the other half be claimed as potential savings. Based on the FY 1983 R&D budget of $44.3 billion, first-year savings of $2.2 billion could be anticipated. Using a 10 percent inflation factor, the savings in the second and third years would be $2.4 billion and $2.7 billion, respectively. Total three-year savings potential is $7.3 billion. Given the savings documented by the DOD Task Force, this level of savings appears reasonable.

Implementation

Strategic planning can be implemented by each agency head by means of administrative action. Because of the importance of strategic planning to the operation of each agency, the Task Force believes that specific direction for implementation must come personally from the head of each agency.

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 2: R&D MANAGEMENT AND THE BUDGET PROCESS

Issue and Savings:

Can the detailed process associated with the budget be improved to make the research and development (R&D) management process more efficient?

The Task Force believes that implementation of its recommendations will significantly improve the overall management of R&D. Major savings opportunities are available in the actual R&D and associated procurement funds. Several PPSS Task Forces recommended changes in this area with estimated savings opportunities of $25.9 billion over three years. These savings opportunities impact both the Research, Development, Test and Evaluation (RDT&E) budget and the associated procurement budget. This Task Force estimates three-year savings opportunities of $3.67 billion in the RDT&E budget if major reforms are implemented in the budget process.

Background

All of the Task Forces that dealt with the Department of Defense (DOD) -- the Office of the Secretary of Defense (OSD), Air Force (USAF), Army, and Navy -- as well as the Task Forces on the Departments of Energy (DOE) and Transportation (DOT), and Procurement focused on problems of R&D and weapons systems acquisition caused in part by the annual budget process and the associated single-year procurement policies. These issues all dealt with the instability that results and the opportunities for savings that exist if the instability is removed.

This issue will address several aspects of R&D management directly impacted by the budget process. By definition, this Task Force is only dealing with the R&D phase. Yet, in several agencies, notably DOD and DOE, the R&D process is tied directly to the procurement process and opportunities for savings extend to those phases as well.

The budget process is the mechanism by which the results of planning for R&D and weapons systems are implemented. This process in the U.S. Government is complicated and takes two calendar years or more to complete in any agency for a particular fiscal year. Exhibit II-3 on the following page presents a simplified overview of the budget process for the FY 1983 budget. Individual sub-agency level organizations began their budget preparation activities in the fall of 1980 (particularly for the larger agencies) for the FY 1983 budget. Agency-level reviews and budget preparation activities commenced in the spring of 1981 culminating in the formal submission of the budget to the Office of Management and Budget (OMB) in September 1981.

The OMB budget review and preparation process began immediately upon receipt and extended to January 1982, with the submission of the President's Budget to Congress. During that period, agency personnel were continually on call to defend their budget, appeal decisions made by OMB, and make the necessary revisions to the overall budget package.

Once the President's Budget is submitted to Congress, the focus shifts to the House and Senate appropriation and authorization hearings process. During this phase the agencies must be prepared to testify and respond to the many Congressional committees and subcommittees with jurisdiction over their budget.

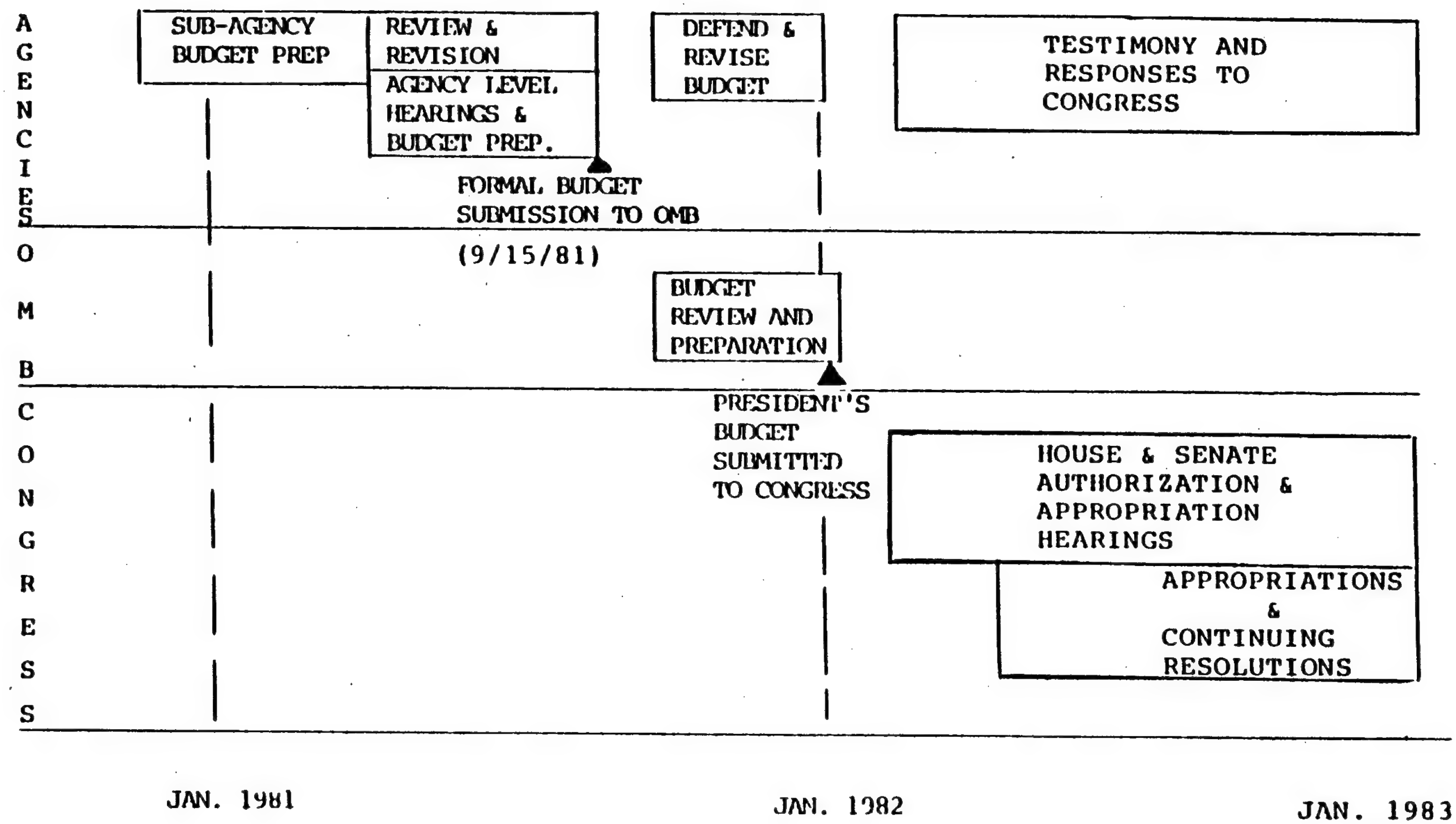
The end result is a series of appropriation bills and resolutions which give the agencies the authority to spend money. For the FY 1983 budget, the completion of the process for the individual appropriations was as follows:

Agency	Date Signed into Law
HUD - Independent Agencies	Sept. 30, 1982
Military Construction	Oct. 15, 1982
Agriculture	Dec. 18, 1982
Transportation	Dec. 18, 1982
District of Columbia	Dec. 23, 1982
Interior	Dec. 30, 1982
(All others were included in the 2nd Joint Resolution)	Dec. 21, 1982

[Exhibit II-3 on following page]

Exhibit II-3

FY 1983 BUDGET PROCESS



That all appropriation activity for the FY 1983 budget was completed by December 1982 reflects the fact that the final session of the 97th Congress was responsible for the bills and any bill not passed by December 31, 1982 would die. In odd-numbered calendar years, when the first session of a Congress is involved, some of the appropriation bills generally are not signed into law until well after the first of the next calendar year, since the same Congress is in session.

Because the agencies cannot legally spend money in any fiscal year until an appropriation is passed, continuing resolutions are used to give them the authority to spend money after October 1. In the case of the FY 1983 budget, the 2nd Joint Resolution included the appropriation language for the other appropriations and had the effect of the normal appropriation bills.

R&D budgets are included in the overall agency budgets and the process for the review and approval of these budgets is the same. There can be one major difference for R&D budgets, however, and that deals with "new starts." Continuing resolutions generally provide that the agency can continue the activities of the prior fiscal year at the prior year's level or the proposed level, whichever is lower. Therefore, when an agency begins operating a fiscal year on a continuing resolution, any new R&D start must wait for the passage of the regular appropriation bill. In certain cases, some new starts are included in the continuing resolutions. This can become a real problem for those budget years handled by the first session of a Congress when certain appropriation bills are not passed until the summer of the fiscal year in question

Methodology

This issue focuses primarily on the R&D management process in four agencies: DOD, the National Aeronautics and Space Administration (NASA), DOE and the National Institutes of Health (NIH). Interviews were conducted at these agencies with the top management personnel most deeply involved in R&D. In addition, interviews were conducted with staff at OMB, the General Accounting Office (GAO), Office of Science and Technology Policy (OSTP), the Congressional Research Service, Congressional Quarterly, the Committee for a Responsible Budget, and private sector firms with extensive R&D programs. The Task Force also reviewed historical trend data on Congressional and agency operations, comparisons of public and private sector R&D organizations, Congressional committee reports and hearing

transcripts, GAO reports, special reports on Federal laboratories and R&D management practice, and various PPSS Task Force reports with issues related to R&D programs.

Findings

In most agencies, budget detail and justification is extensive, requiring information on numerous projects including those of relatively small size. In FY 1983 there are some 1,822 projects in NASA, DOD and DOE for which budget detail is provided. Exhibit II-4, on the following page, provides a summary of the budget justification submitted by the four principal R&D agencies: DOD, NASA, DOE, and HHS (NIH).1/

The top half of the exhibit shows that DOD, NASA and DOE supply detailed, project-level information on projects as small as $100,000. The average project size is $9.8 million in NASA and in excess of $31 million in DOD and DOE. In the lower portion of the exhibit, the sized distribution of R&D projects within DOD is shown. Although the average-sized project in DOD is $31.6 million, the distribution data indicate that roughly 75 percent of the projects are smaller than average.

The exhibit also shows a striking contrast between the NASA, DOD and DOE budgets and the NIH budget. In NIH's case, the budget is communicated in terms of total program levels, number of personnel, and an analysis of major program changes for each institute.

The time involved in the budget process is excessive and contributes to the cost growth problem. The two to three years lag in the budget process between initial budget planning and subsequent funding actions makes management and planning difficult tasks. In an R&D environment with its rapid technological change, uncertainty and inflation, planning and management are much more difficult. Time lags of this nature, however, do not cause problems in budgeting such operational functions as medical payments, civil service payroll, and grants and loans.

[Exhibit II-4 on the following page]

1/ The R&D budget justification package for DOD is approximately 3,000 pages; the same package for NASA is 1,000 pages.

Exhibit II-4

FY 1983 R&D FEDERAL BUDGET DETAIL

	No. R&D Projects	Average $/Project ($ millions)	Lowest Level of Project $ ($ millions)
NASA	673	$ 9.8	$0.1
DOD	768*	31.6	0.1
NIH**	NA	NA	NA
DOE	381	31.9	0.1

Analysis of FY 1983 DOD Budget Detail

No. R&D Projects	$1M & Under	$1M-$2M	$2M-$5M	$5M-$10M	$10M-$20M	$20M-$30M
Army	10	15	36	42	32	17
Navy	9	25	63	69	55	25
Air Force	9	9	31	31	28	24
Defense Agency	1	5	10	8	15	1
Total	29	54	140	150	130	67
Cumulative total by Service		83	223	373	503	570
% of total (768)	3.8%	10.8%	29.0%	48.6%	65.5%	74.2%

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* Unclassified only.

** NIH R&D budget data are developed in detail within the agency (more than 2,000 in-house R&D projects and more than 15,000 extramural grants). However, summary data are used for communicating and reviewing the budget with emphasis on the total program level, number of personnel, and analysis of year-to-end program changes for each institute.

Because of the lags, R&D budgets are established on the basis of highly uncertain information. In the fall of 1980, program/project managers began developing their detailed budget submissions for expenditures in FY 1983. In an R&D environment where by definition the future is uncertain, developing detailed funding plans that far in the future presents major problems. The problem is exacerbated for new starts where the R&D project is not defined. In these cases the rush to get the project included in the budget to be considered precludes the kind of definitional planning that should be done. A NASA study of the cost growth problem (the Hearst Study) cited inadequate definition prior to the budget decisions as an element contributing to the cost growth.

The lack of definition and the lead times involved can cause subsequent cost growth in R&D projects because the initially requested amounts become commitments on the part of program managers. By the time the budgeted amounts are available for spending, technology changes and the results of the prior years R&D efforts may indicate that a different amount of money is required. In such cases, program managers first try to live within the assigned ceilings by revising the scope of the project or changing the schedule. When they do, they are caught in the situation that leads to real cost growth. Many recent reports on cost growth [the Rand Corporation's "Acquisition Policy Effectiveness" and the Air Force Systems Command (AFSC) "Affordable Acquisition Approach"] have shown that program stretch-outs and changes in technical requirements are contributing factors to cost growth.

In the AFSC study of cost growth, they found funding instability as the cost and schedule growth factor that occurred most often. External management impacts (defined as the occurrence of program decisions above the program office or the occurrence of frequent program reviews at USAF headquarters or higher) was the fourth most prevalent factor in cost and schedule growth.

The budget cycle in the private sector does not involve any delays of the magnitude encountered in the Government. Relying on our own experience and based on information obtained from other private sector firms, we have developed the following general scenario explaining how R&D programs are budgeted in the private sector.

- New projects are generally included in the overall five- to ten-year strategic plan which receives general approval. The projects are described in brief terms and budgets are stated in ranges of dollars such as $50-$75 million.

- When it comes time to approve a specific project, detailed plans and a budget are prepared. They are then submitted to the Board for approval. This whole review and approval cycle generally takes 30-60 days. In general, this approval process is outside the annual budget cycle.

- If annual approval is required for continuation of the project, it is generally handled as part of the normal budget cycle which takes two to four months.

We do not mean to imply that the Federal R&D budget process should adopt the same specific type of schedule as in the private sector. We recognize that in the private sector decisions are made on project proposals by an individual or a small group. In the Government, decisions require a consensus in the agency, the Executive Office of the President, and Congress. Nevertheless, the length of the process is a major management problem and it should be shortened.

The Congressional hearings process places a significant burden on the agency. There are 30 Congressional committees and subcommittees that have jurisdiction over DOE. In the 97th Congress alone, DOE presented over 700 witnesses at more than 300 hearings. This problem is not unique to DOE. Other agencies have found themselves appearing before an expanding array of Congressional committees. In the case of DOD, for example, they have recently had to appear before the Interior and House Ways and Means Committees, in addition to their numerous appearances before the Armed Services and Appropriations Committees. Each of these hearings requires time for preparation of testimony. In addition, considerable time is required to respond to written requests for information on the part of the Committee, most of which are generated by growing staffs.

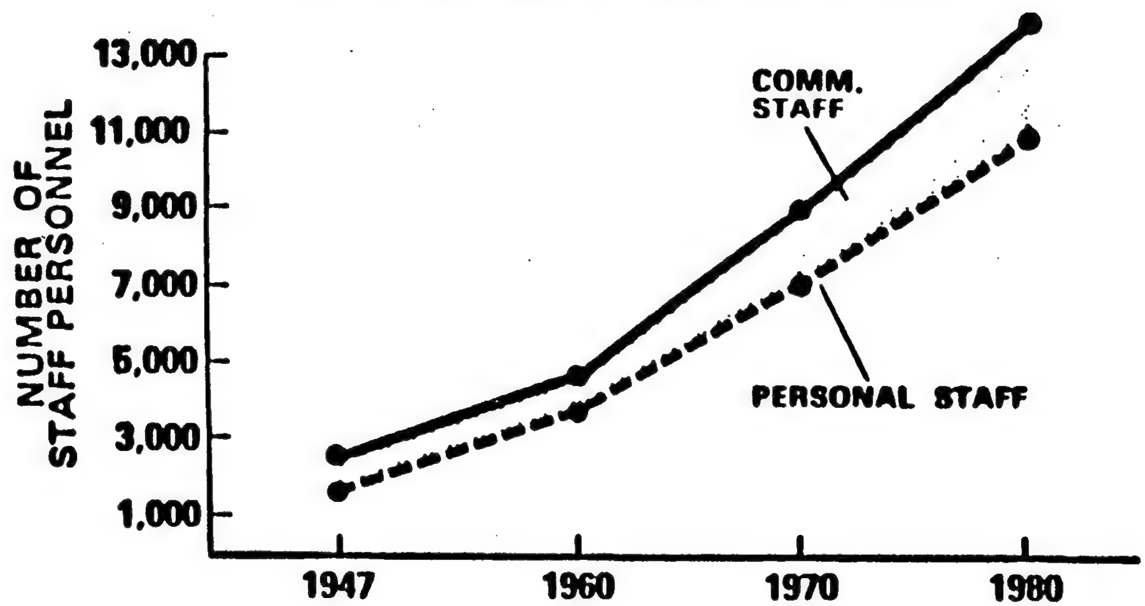
Since World World II, Congressional staffs have increased about sixfold (See Exhibit II-5 on the following page). The Committee staffs, as opposed to the personal staffs of individual members of Congress, have grown 11.7 times in 33 years (1947-1980). Exhibit II-6 shows the growth in staff for those key committees which most influence the four large R&D agencies. The House Energy and Commerce and Public Works Committee staffs alone have increased by a factor of 16, and the number of staff members on a single committee, Energy and Commerce, has reached 165. Despite this growth, the actual number of committees has grown only 25 percent since 1955-56.

[Exhibits II-5 and II-6 on the following pages]

EXHIBIT II-5

CONGRESSIONAL STAFF SIZE 1947-1980

(PERSONAL AND COMMITTEE STAFF)



	1947	1960	1970	1980	1980-1947 RATIO
PERSONAL STAFF1/	2,030	3,556*	7,706**	11,117	5.5 TO 1.0
COMMITTEE STAFF2/	293	641	1,079	3,449***	11.7 TO 1.0
COMBINED TOTAL	2,323	4,197	8,785	14,566	6.3 TO 1.0

*1957
**1972
***1981

SOURCE: (1) VITAL STATISTICS ON CONGRESS, 1980
(2) OFFICIAL PAYROLL RECORDS OF HOUSE AND SENATE

Exhibit II-6

CONGRESSIONAL STAFF SIZE (R&D OVERSIGHT COMMITTEES)

Number of Committees in the House and Senate (1955-1980)

	84th Cong. (1955-56)	90th Cong. (1967-68)	92nd Cong. (1971-72)	97th Cong. (1981-82)
Total Number of Congressional Committees	242	315	333	310

Congressional Staff Size -- Key R&D Oversight Committees

House Committees	1947	1960	1970	1981	1981 to 1947 Ratio
o Appropriations	32	51	71	140	4.4 to 1.0
o Energy & Commerce	10	41	47	165	16.5 to 1.0
o Science & Technology	--	16	29	88	5.5 to 1.0
o Public Works	6	24	43	95	15.8 to 1.0
o Armed Services	10	16	40	54	5.4 to 1.0
o Education & Labor	10	20	102	135	13.5 to 1.0
Senate Committees					
o Appropriations	21	25	33	84	4.0 to 1.0
o Commerce, Science and Transportation	7	10	10	115	16.4 to 1.0
o Energy and Natural Resources	10	10	10	56	5.6 to 1.0
o Armed Services	9	9	8	42	4.6 to 1.0
o Labor and Human Resources	7	22	34	134	19.1 to 1.0

Source: Official Payroll Records of House and Senate.

The argument often used to justify this growth is the increased complexity in running the Federal Government. However, even by Government standards this growth appears excessive. For example, Exhibit II-7, on the following page, shows that civilian and military Federal employment in the Executive Branch has increased less than 50 percent over the same period (about the same growth as the United States population) including the growth in military personnel resulting from the Vietnam conflict.

Both the internal agency review process and the OMB and Congressional review process have created extensive layering in Federal R&D agencies. This results in excessive use of technical staff and micromanagement at numerous and high levels within the agencies. Large technical staffs are used to evaluate programs and advise upper management. These technical staffs who support the management structure do not have direct line responsibility (i.e., they do not manage or have responsibility for a program or function). The use of these technical staffs has grown to the point where it undermines the authority and responsibility concept of management. The staffs are so large that they have an organization and layered structure of their own.

Two of the Task Forces specifically addressed this issue as it applies to R&D.

- The Department of the Air Force Task Force recommended changes in the Air Force budget preparation and review cycle. They found that virtually the entire Air Staff is involved in the preparation or defense of the Program Objective Memorandum (POM) and the budget which are done sequentially. The Task Force recommended that the Planning, Programming and Budget System (PPBS) reviews and budget reviews be done at the same time and estimated that 120,000 staff-hours could be saved in the process. This analysis focuses primarily on the resources used in the internal agency review process. It does not address the staff required to respond to the Congressional deliberations phase of the budget process.

- The Department of Energy Task Force found an unnecessarily expensive structure of program direction and support in the Department and labs. They found a complex network of program managers and control personnel involving successive layers of people who oversee, monitor and

[Exhibit II-7 on the following page]

Exhibit II-7

FEDERAL EMPLOYMENT COMPARED TO CONGRESSIONAL STAFF SIZE

	1947	1960	1970	1980	1980 to 1947 ratio
Full-time civilian employment (Executive Branch)	2,082,000	2,371,000	2,994,000	2,821,000	1.35 to 1.0
Uniformed military employment	1,583,000	2,837,000	3,477,000	2,366,000	1.49 to 1.0
Combined civilian and military Federal employment	3,665,000	5,208,000	6,421,000	5,187,000	1.42 to 1.0
U.S. population	144,698,000	180,584,000	205,052,000	228,297,000	1.58 to 1.0
Congressional staff committee size	293	641	1,079	3,449	11.7 to 1.0

Source: Federal Budget Special Analysis F: FY 1969, and Special Analysis I: FY 1983; Official Payroll Records of House and Senate.

often participate in the management of laboratory programs. Their recommendations for improving the situation would eliminate 600 positions in DOE and 1,800 positions in the GOCOs (Government-Owned, Contractor-Operated facility).

We analyzed the R&D management structure in the Army and compared it to the private sector. The results of this analysis are shown in Figure II-1 and II-2 which follow this page. Figure II-1 presents the current R&D organization and technical staff in the Army. (All nontechnical staff, of which there are many, are not shown.) As shown in this exhibit, there are roughly 600 people involved in technical staff positions with respect to the Army R&D program.

This use of technical staff in the Government is extensive when compared to private sector R&D organizations. Figure II-2 shows an organizational chart for a typical industrial R&D firm. In this example, no technical staff serve in the top management structure. While Government may not operate like industry, the striking difference between these two examples cannot be justified in the organization. In our interviews with Army R&D management, they continually referred to this problem, pointing out that many people have to be lined up to make relatively simple decisions. Many can veto a decision but very few can give a go-ahead. This causes frustrating delays, lack of accountability and great waste in R&D program management resources.

These staff problems are caused, as shown by the Air Force example, by internal management inefficiencies, by the extensive micromanagement practiced internally as well as by external agencies, and by the Congressional budget process. To illustrate the magnitude of the problem, we analyzed the DOD RDT&E budget for FY 1983 and the control procedures used by Congress.

As noted previously in Exhibit II-4, there are 768 unclassified items in the DOD R&D budget. There is agreement between DOD and Congress that the Secretary of Defense has the authority to reprogram funds up to $5 million without prior Congressional approval. However, this agreement also contains the provision that reprogramming of any individual item changed by Congress in the budget deliberations cannot be done without prior approval of Congress. A review of the FY 1983 RDT&E budget reveals that roughly 90 percent of the items were altered during Congressional deliberations. This has the effect of eliminating the reprogramming authority.

[Figures II-1 and II-2 on the following pages]

Figure II-1

DOD (ARMY) ORGANIZATION CHART

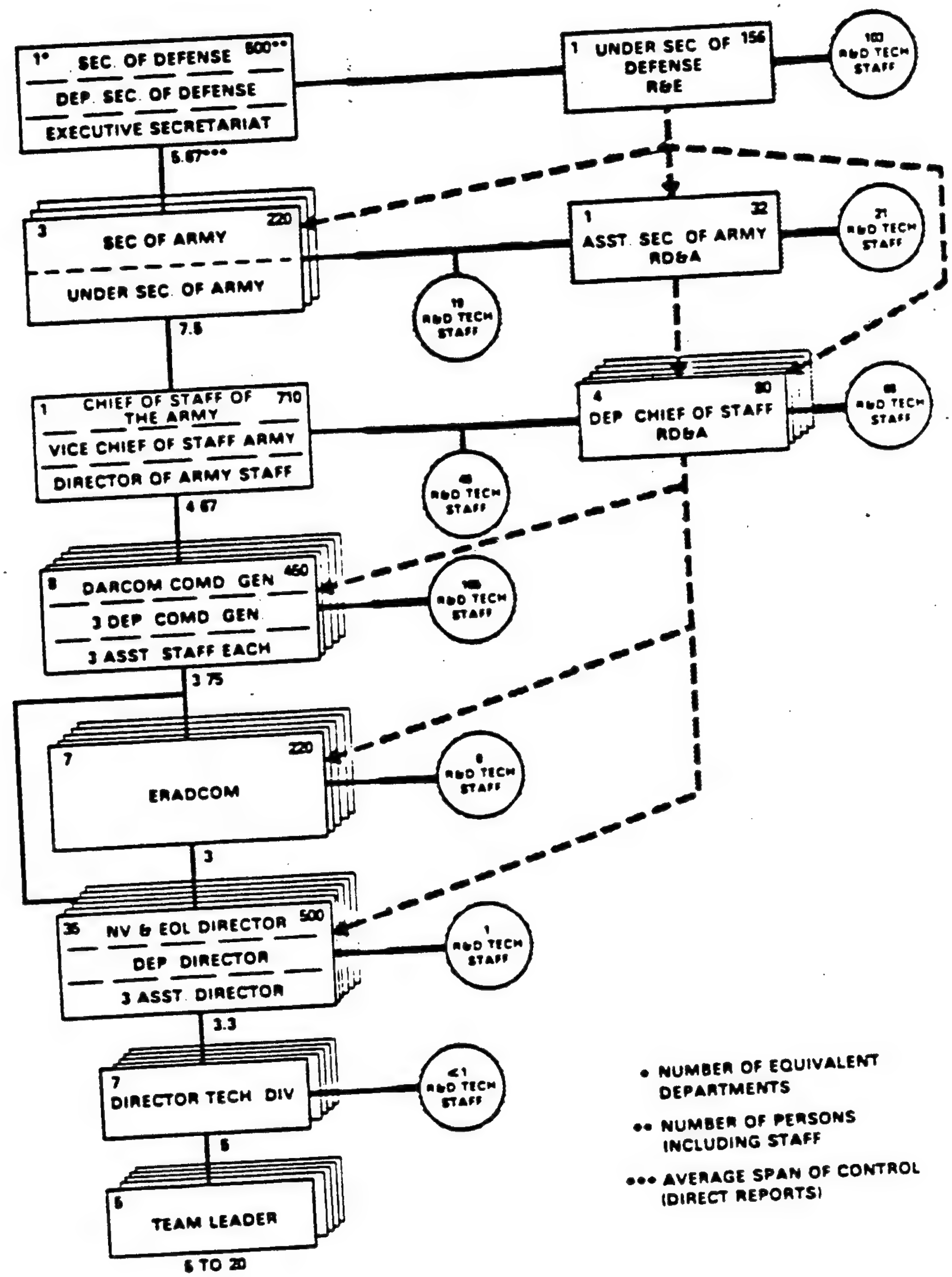
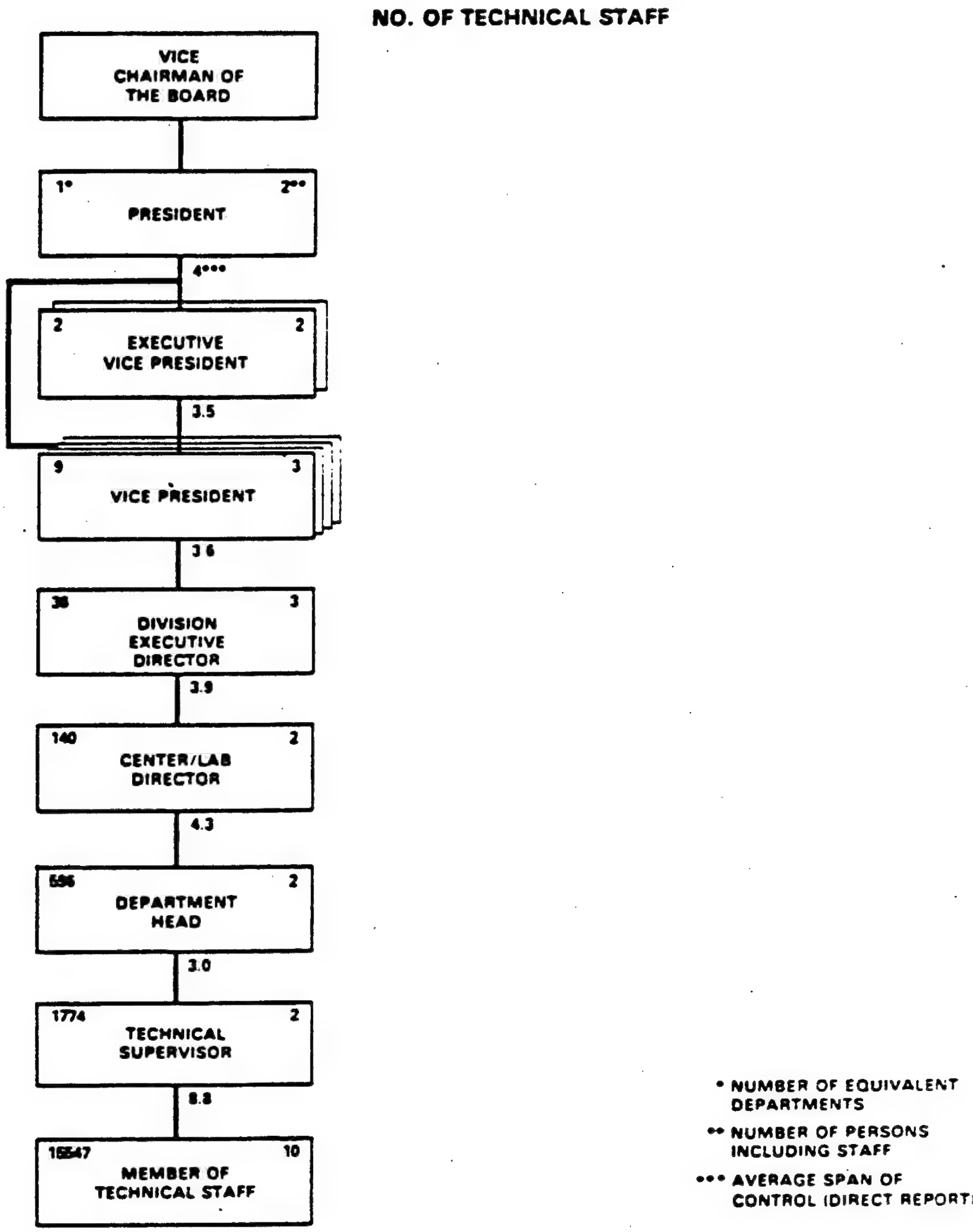


Figure II-2

$2 BILLION INDUSTRIAL R&D FIRM



The impact of this micromanagement and internal processes in OD and DOE can be seen in the following table 2/ which compares overnment and private sector management ratios.

rganization	No. of Managers & Supervisors	Total No. of Employees	Management Ratio	Average No. of Workers Per Manager
ederal Government Dept				
Defense	138,066	668,150	20.7%	3.8
Energy	2,776	17,298	16.1%	5.2
Private Sector Company				
IBM	45,600	364,796	12.5%	7.0
Exxon	25,604	173,000	14.8%	5.8
Honeywell	12,228	94,062	13.0%	6.7
3M	14,856	87,388	17.0%	4.9
Hewlett-Packard	10,608	68,000	15.6%	5.4

As can be seen in these figures, the average number of workers per manager, particularly in DOD, is low in comparison to major technology oriented private sector firms.

2/ The table is extracted from a PPSS Special Report on Organizational Effectiveness to be released during November 1983.

Conclusions

As shown in the Findings, the R&D management process, particularly those processes dealing with the annual budget cycle, are inefficient, lead to tremendous administrative burdens, and contribute to the cost growth being experienced by many R&D programs. All aspects of this process require change to reduce the time lags involved as well as the level of detail required. The problem of excess staffs in both the Executive and Legislative Branches is, to a certain extent, a chicken and egg argument. From one perspective, they are needed to handle the growing complexity and level of detail involved. From another, the complexity and level of detail are growing because of these staffs.

At the same time, the Task Force recognizes that the process can not be governed by the desired efficiency in R&D management. The system of checks and balances built into the system, as inefficient as they might be, has served the country well. Nevertheless, the Task Force is convinced that certain fundamental changes can be made which will improve the efficiency of the process without harming the other objectives served by the process.

Recommendations

R&D 2-1: Implement multiyear budgeting specifically for R&D activities. The Task Force on Federal Management Systems has recommended that multiyear budgeting be con- sidered as an issue for further study. Many of the other task forces have recommended that multiyear budgeting be implemented for various portions of Government operations including R&D and weapons systems procurement. This Task Force believes that this concept will be helpful in solving some of the problems associated with R&D management, parti- cularly eliminating some of the annual effort involved in budget preparation and review. Such an approach would also provide more stability to the R&D efforts, providing known funding levels for future years of essential R&D programs.

R&D 2-2: Develop a budget concept that significantly reduces the level of detail in the budgeting of R&D programs. As noted in the Findings section, the approval of budgets for 1,822 individual projects for DOD, DOE and NASA gets into an excessive level of detail. At the other extreme, if the R&D budget for the three Services, DOE and NASA were approved at a total level, the Congress would not be exercising the degree of oversight appropriate to its role.

The Task Force recommends that the budget for the DOD R&D program be presented in terms of the three Services and further broken down into the existing budget activities (technology base, advanced technology development, strategic programs, tactical programs, intelligence and communications, and defense-wide mission support). Within each budget activity two or three major programs would be identified for information purposes only.

There are alternative structures that could be used for these budget activities. In the Army, for example, it might be more meaningful to break the R&D budget down into the following functions:

- armament,
- aviation,
- communication,
- mobility equipment,
- missiles,
- tanks, and
- troop support.

A similar functional list could be prepared for the other Services, DOE and NASA.

The Task Force is not in a position to specify the categories that should be used. However, some scheme to get to more summary level information as currently used by NIH should be developed.

<u>R&D 2-3: Develop ways to shorten the budget preparation and review cycle</u>. Certain recommendations contained in this Report should shorten the current budget cycle. The recommendations dealing with strategic planning should significantly reduce the time required for the individual agencies to prepare the budget package for submission to OMB. Also the recommendations for multiyear budgeting would eliminate the annual cycle of the budget process. The largest portion of the cycle that has not been addressed is that taken up by the Congressional deliberations. We recognize that this portion of the cycle is outside the scope of the PPSS review. Yet, we must note that it is contributing to the inefficiencies in Government operations.

Various Congressional budget reforms have been recommended over the course of the last several years. One of the strongest arguments has been made by Dr. Alice Rivlin,

former Director of the Congressional Budget Office. She believes that Congress has overloaded its own decision-making process. As one step to simplify the process and reduce this load, she has repeatedly recommended that Congress adopt a multiyear budgeting process. Similar recommendations on budget reform have been advanced by the current and the former GAO Comptroller General, as well as many individual Congressmen.

As part of the negotiation with Congress, which will be required to implement multiyear budgeting and the reduction in the level of detail contained in the budget, the Executive Branch should explore ways to reduce the time required for Congressional review. One alternative might be to separate substantive program review (authorizations) from the formal budget cycle (appropriations), i.e., approve a funding level for the entire R&D program and establish an authorization cycle that is not tied to appropriations. A second alternative might involve the scheduling of R&D deliberations early in the overall cycle in order to shorten the time frame.

R&D 2-4: Reduce technical staff positions in all R&D agencies. The preceding recommendations are directed toward streamlining and revising the R&D management process, particularly the budget process. As these recommendations are implemented there will be an opportunity to reduce the technical staffs that have developed in the R&D management process.

It is recommended that the number of technical staff and support personnel in R&D organizations be reduced to eliminate confusing lines of authority and unproductive staff work. Because the Task Force did not have the resources to analyze the staffing of R&D management agencies, it is not possible to specify the number of positions that should be eliminated.

A PPSS special report on Organizational Effectiveness, which will be released in November 1983, recommends a program for achieving a more effective Government organization structure. Implementation of these recommendations, in conjunction with the changes recommended in the report, should result in an improved R&D management process, operating with a reduced technical staff.

Savings and Impact Analysis

The recommendations presented in this issue should result in reductions in cost growth and savings in acquisition costs through improved program stability. In part, these savings have been addressed in R&D 1 and the various

PPSS reports dealing with the agencies with primary R&D responsibility. On the following page is a listing of the recommendations for multiyear budgeting/procurement and the savings opportunities that have been identified in other PPSS reports. 3/

These savings opportunities apply to both R&D and procurement funds and there is some duplication between the items, so the total cannot be claimed as savings opportunities for this analysis.

In order to attribute savings opportunities to these recommendations the analysis used in ENERGY 13 will serve as the base. In that issue, the Task Force used 5 percent of the R&D budget as the estimated savings opportunities attributable to multiyear budgeting.4/ Recognizing that we are applying the rate to a larger base, this Task Force will use a 2.5 percent rate as the annual savings opportunities attributable to the budget reforms recommended in this issue. Based on the FY 1983 R&D budget of $44.3 billion, first-year savings opportunities would be $1.11 billion. Applying a 10 percent inflation rate, second-year savings would be $1.22 billion and third-year savings would be $1.34 billion. Total three-year savings would be $3.67 billion.

Implementation

Implementation of these recommendations will require Congressional approval. OMB and the affected agencies should initiate discussions with the appropriate Congressional staff to begin working out the revised procedures.

3/ The Task Force recognizes that the recommendations for multiyear procurement do not necessarily imply a need for multiyear budgeting. However, the increased stability provided by multiyear budgeting would greatly enhance the recommendations. Also the implementation of multiyear budgeting does not obviate the need for multiyear procurement authority.

4/ In the OSD report (OSD 23), a 7.5 percent factor was estimated for savings attributable to multiyear budgeting.

Multiyear Budgeting/Procurement Savings Opportunities

Task Force/ Issue	Title	Three-year Savings Opportunities ($ millions)
ARMY 11:	Fully funded biennial budget for major weapon system procurement	$ 6,600.0
ENERGY 13:	Introduce three-year budgeting	413.7
NAVY 1:	Improvements in program stability including a two-year budget	3,000.0
OSD 23:	Reduce instability in the weapons acquisition process	7,185.0
PROC 4:	Expand multiyear contracting to all agencies	3,415.0
PROC 6:	Develop program management and acquisition plan	2,940.0
USAF 19:	Increase use of multiyear procurement and propose a multiyear budget	2,400.0
	Total savings opportunities	$25,953.7

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 3: PRIVATIZATION

Issue and Savings

Can cost savings be realized if the Government privatizes certain Federal research and development (R&D) undertakings?

The Federal Government has a recognized role to play in supporting R&D in the United States, but areas exist where transfer of R&D responsibilities to non-Government entities would generate cost savings and strengthen R&D capabilities.

Background

According to the President's Private Sector Survey (PPSS) Task Force Report on Privatization, "Privatization, in a literal sense, means to turn over an activity, or part of an activity, currently performed by the Federal Government to a non-Federal entity." The Federal Government often becomes initially involved in activities for legitimate reasons. For example, military commissaries arose in the 1860s when the typical army post was a frontier post, miles from the nearest city. The most cost-effective way to provide military personnel with food and supplies was to make the Federal Government their grocer. However, the circumstances that originally justify Government production of goods and services often change, so that eventually non-Federal entities can and should take over production.

In the R&D arena, Government clearly has a role to play in supporting and undertaking R&D activities. Consider the Government role in the following cases:

R&D That Entails Major Expenses, But Whose Outcome Is Highly Risky -- There are scientific and technological areas important to the United States that are too expensive and risky to be developed by the private sector. In such

cases, the Federal Government can appropriately become involved in relevant R&D activities. For example, the Federal Government's willingness to underwrite the risks involved in the transistor's early exploitation.

Very Long-term R&D -- Some R&D work involves planning horizons that extend beyond the normal planning horizons of industry. It is appropriate for the Federal Government to support actively such R&D. If significant progress in fusion-based energy system research is to be realized, Government must play an active role in its development.

Public Good Areas -- The Federal Government is clearly responsible for doing such things as maintaining the national defense and assuring the existence of a good public health system.

Maintenance of the National R&D Infrastructure -- Only the Federal Government possesses a national perspective on R&D. For example, while an individual electronics firm may be concerned about where it will find electrical engineers to fill staff openings in its labs, the Federal Government is concerned with having an adequate supply of electrical engineers to meet all the corporate and non-corporate needs of the United States. It is also concerned with developing an adequate cadre of scientists and engineers in all other areas of science and technology.

Maintenance of the U.S. Competitive Position in Crucial Areas -- While we are far from having universal agreement on this matter, there are many who believe that the Federal Government should do whatever is necessary to make certain that the U.S. does not lose its leadership position in certain key scientific and technological areas; e.g., in electronics, computers, and aerospace. This view has arisen in response to foreign challenges to American dominance in these areas, challenges that have their origins in foreign government subsidies of their domestic R&D efforts (e.g., in Japan, France, and many Third World countries).

While Government has an important role to play in supporting R&D efforts, care must be taken to make certain that legitimate Government-supported efforts do not, over time, become incursions into non-Governmental terrain.

Methodology

The R&D-related issues of all the PPSS Task Forces were reviewed to identify areas where Federally supported R&D can be privatized across a broad spectrum of Federal agencies. Interviews were conducted with high level personnel in both the Federal and non-Federal sectors. Relevant literature was reviewed.

Findings

The PPSS Task Force on Privatization made a distinction between the Federal Government providing goods or services and producing them. There are many goods and services that the Federal Government can legitimately provide to the public, but the number that it should produce is far smaller. In this scheme of things, privatization primarily entails reducing the Federal Government's role as a producer of goods and services.

In our Report, we carry the concept of privatization even further. Our investigations have led us to the following three broad findings:

- The Federal Government should divest itself of R&D tasks:
  - that would otherwise be effectively done were the Government is not involved.
  - that can more efficiently be done by non-Government entities.
- The Federal Government should create an environment that stimulates increased non-Federal R&D activity in certain target areas.
- Non-Federal entities should be profitably encouraged to use Federal R&D facilities and the results of Federally sponsored R&D.

There are two basic ways to accomplish divestiture. One way is to farm out to non-Government entities tasks that Government legitimately needs to have performed. Thus, while Government would provide necessary R&D services, it would not be producing them itself. Examples include the environmental testing done by Environmental Protection Agency (EPA) field workers throughout the United

States, and the later development phases of Department of Defenses (DOD) research.

The Federal Government can also divest itself of R&D undertakings by getting out certain R&D areas entirely. This should happen when it is obvious that the R&D would be carried out by non-Federal entities even without Government involvement, or when it is determined that the R&D is not meritorious for Federal involvement. It is assumed that R&D projects that were meritorious from the private sector point view would be picked up. The following are some specific examples of programs that the Federal Government should divest itself of:

- The PPSS Task Force examining the Tennessee Valley Authority (TVA) determined that the Federal Government should phase out its support of the National Fertilizer Development Center (NFDC). The NFDC has been quite successful in carrying out its mission. At this point private funding sources can support NFDC's work. A gradual phase-out of Government support would yield a savings of $12.1 million in the first year, $27.1 million in the second year, and $44.6 million in the third, for a total three-year savings of $83.8 million (See BUS-TVA 7).

- In reviewing the Cooperative State Research Service (CSRS), the PPSS Task Force on the Department of Agriculture found that 20 low priority CSRS projects could be dropped by the Federal Government, transferred out of the Agriculture Department to other agencies or transferred to non-Government entities. Those projects transferred to non-Federal entities would save the Federal Government over $10 million a year in expenses, for a total savings of $35.4 million over three years (See AG 54).

- The PPSS Task Force on the Department of Energy (DOE) concluded that DOE should not support projects that can be adequately handled by the private sector (e.g., ocean thermal energy conversion). While the Task Force did not suggest a dollar figure for the savings realized by privatizing certain energy R&D efforts, it is clear that the savings would be very large, ranging in

the hundreds of millions or even billions of dollars (See DOE 11). 1/

- The PPSS Task Force on Privatization determined that if funds for the fifth space shuttle were collected from the private investors, cost avoidances totaling $460 million in the first year, $506 million in the second year, and $556.6 million in the third year could be realized for a three-year total of $1,522.6 million. Currently, two shuttles have been procured and constructed with two more in the works. There are no plans for a fifth shuttle. However, it seems clear that the demand for space shuttle services will exceed the capacity of the four shuttles, so that it is reasonable to assume that a fifth shuttle will have to be built. By bringing private investors into the procurement of the fifth shuttle, the Federal Government would be making a significant step in privatizing what will some day be a major American industry (See PRIVATE 3).

It should be recognized that privatization can be encouraged through indirect means. By creating an environment that reduces the level of risk in R&D investments, the Federal Government can stimulate increased R&D activity in the areas that the private sector normally avoids.

The Federal Government should continue to explore mechanisms such as the R&D tax credit, the R&D limited partnership (R&D LP) and R&D joint ventures (R&D JVs).

The Federal Government undertakes large quantities of R&D either in-house or through contracts. A significant consequence is R&D assets valued in the billions of dollars. These take the form of laboratories, equipment, production facilities, and a large cadre of well-trained scientists and engineers. They also include control over an enormous amount of technology patented by the Federal Government. To the extent that these assets are amassed by the Government, they are not being utilized effectively. The R&D Task Force suggests that attention focus on the

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1/ It has been estimated that the annual savings in Federal outlays for energy research could amount to $2 billion, with greater future savings (Heritage Foundation, Backgrounder $270, "Privatizing Federal Energy Research," June 7, 1983).

following three ways of increasing the flow of technology from the Federal to the non-Federal sector:

- o Non-Federal entities can be given improved access to the facilities of Federal laboratories.
- o Information on Federally supported efforts can be more effectively disseminated to the public.
- o Non-Federal entities can be encouraged to license Government-owned patented technology.

While the second and third items are discussed in separate issues in this Report, improved access to the facilities of Federal laboratories is briefly discussed here. DOE labs have "user facilities" in which either Government or commercial entities can pay to have experiments conducted or analyses made. A prime example is Brookhaven National Laboratory's Synchotron Light Source, a unique diagnostic tool for studying such commercially important materials as alloys, catalysts, and polymers. The facility is available on a time-sharing basis. Despite recent publicity, some potential users (including large beneficiaries) may still not know of the facilities existence, much less its possible application to problems with which they are concerned.

Various gains can be realized from closer interaction between the national laboratories and the private sector. The private sector would get access to specialized equipment and expertise, in addition to gaining insights into high-risk, long-term work being performed at the labs that may ultimately have commercial significance. For its part, the laboratories would get a clearer value. They would also be able to identify and discontinue research in the Government sector that private companies and research institutions are already performing.

Conclusions

The Federal Government has a legitimate role to play in R&D. This is particularly important for maintaining the national science and technology infrastructure and in the areas of long-term, high-risk R&D and public good-related R&D. However, the Government must be wary of undertaking R&D efforts that could be adequately undertaken by non-Government entities.

There are many R&D efforts currently funded by the Federal Government that should be turned over to the private sector, or abandoned if the private sector is not interested. The two most noteworthy examples are the Clinch

River Breeder Reactor Project and the National Fertilizer Development Center.

There are several different ways in which privatization of Federal R&D can occur. The Government can directly transfer Federally related R&D task to non-Government entities; it can divest itself fully of tasks which it should not be performing; it can create an atmosphere that encourages greater private sector participation in high-risk, long-term R&D ventures; and it can encourage non-Government entities to take better advantage of the fruits of Government-sponsored R&D

Recommendations

R&D 3-1: Federal agencies should identify areas where they provide R&D goods and services that can better be produced by non-Federal entities. Where logical, they should strive to transfer the production of these goods and services to non-Federal entities.

R&D 3-2: Federal agencies should periodically assess the R&D activities they support to identify activities no longer deserving support on the grounds that they compete with the efforts of the private sector or are not worthy of Federal sponsorship. Where logical, the agencies should divest themselves of these activities in their entirety.

R&D 3-3: The Federal Government should strive to create an environment that encourages increased private sector participation in high-risk, long-term projects by expanding R&D tax credits, and R&D incentives like R&D limited partnerships and joint ventures.

Savings and Impact Analysis

The majority of benefits derived from privatizing R&D cannot be readily quantified. For example, it is difficult to speculate on the value of increased tax revenues gained for successful privatization or cost savings that might be realized by letting market forces increase the productivity of the R&D process.

To illustrate the savings potential from privatization of R&D, we have summarized the savings identified by other Task Forces in the table on the following page.

Cost Savings/Avoidance

($ millions)

Source of Savings	Year 1	Year 2	Year 3	Three-year Total
National Fertilizer Development Center	$ 12.1	$ 27.1	$ 44.6	$ 83.8
Cooperative State Research Service	10.7	11.8	12.9	35.4
Clinch River Breeder Reactor 2/	200.0	200.0	200.0	600.0
5th Space Shuttle	460.0	506.0	556.6	1,522.6
Total	$682.8	$744.9	$814.1	$2,241.8

These savings are shown here for illustration purposes only since they have been included in the other Task Force reports. They are not counted as savings attributable to this issue, but are included in the Compendium Issue (R&D 8).

Implementation

Statutory and administrative authority exists to implement all the recommendations offered here (e.g., Stevenson-Wydler Act, OMB Circular A-76). Implementation can be undertaken at the agency level.

2/ The savings for the Clinch River Breeder Reactor are estimated since there are no annual appropriation requests for the project. In FY 1983, $194 billion was appropriated for the project. DOE requested that Congress appropriate $1.5 billion to be obligated through 1990 which, when combined with planned private sector funding would complete the project. Therefore, it was assumed that $600 million would be saved in three year. Total savings through 1990 would be $1.5 billion.

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 4: IMPROVED MANAGEMENT OF RESOURCES IN FEDERAL RESEARCH LABORATORIES

Issue and Savings

Can Federal research and development (R&D) costs be reduced by managing funds, personnel, facilities and equipment of Federal research laboratories more effectively?

Savings from improved resource management are estimated to be $153.0 million in the first year, $168.3 million in the second year, and $185.1 million in the third year for three-year total savings of $506.4 million.

Background

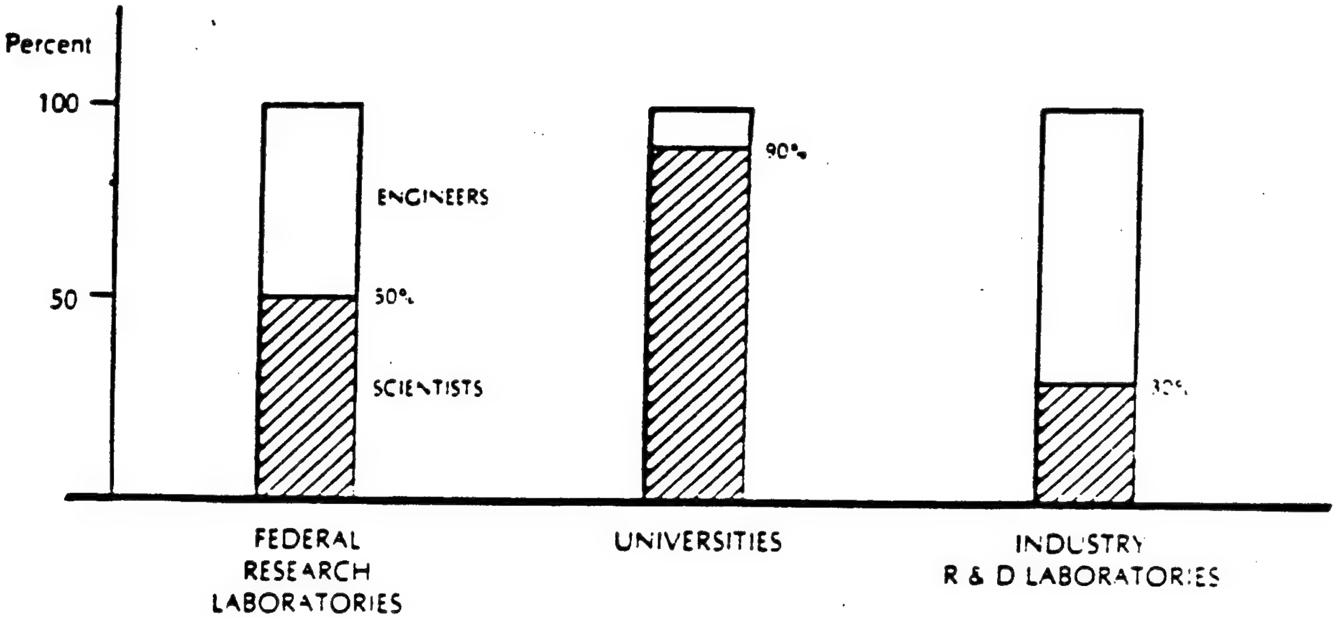
Over the past ten years, there has been an upward trend (in constant dollars) in total Federal funding for R&D, which is conducted in three major performing sectors: industry, Federal laboratories, and universities. The fraction going to Federal laboratories has been relatively constant over that period. In general, industry is principally involved in development, the Federal laboratories in development and applied research, and universities in basic research (see Exhibit II-8 on the following page). There are, however, many exceptions. The overlapping capabilities among the three performing sectors in many areas of endeavor make it increasingly difficult to identify capabilities truly unique to any one sector. In addition, all sectors need to maintain some level of activity in basic science and engineering to support the more applied aspects of their work.

The Federal laboratories, however, share a common role and purpose. They provide scientific and technical services to the sponsoring agencies that manage them. Through their research, they contribute to agency planning, program development and policymaking. Many of the laboratories' original objectives have been met, however, and some of the missions are no longer relevant. Also, industry and the universities now have significantly greater research

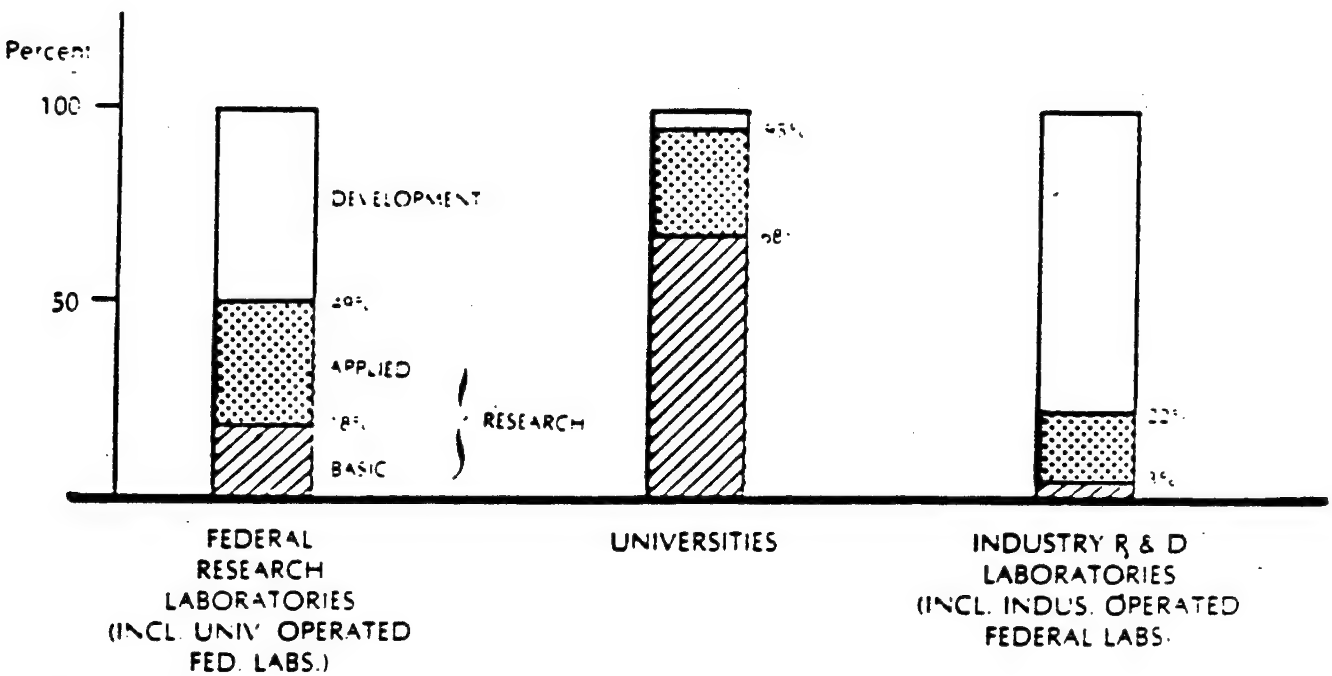
[Exhibit II-8 on the following page]

Exhibit II-8

RELATIVE PERCENTAGE OF SCIENTIST AND ENGINEERS EMPLOYED IN R & D, BY SECTOR



NATURE OF R & D BY SECTOR



SOURCE: National Science Foundation

capabilities. The Federal laboratories have responded to changing environments in different ways, as have industry and the universities. Some laboratories have remained static, while others have changed their charters from their original purposes. The Federal Government must ascertain whether these laboratories are attending to the most relevant activities.

The Federal Government owns more than 700 laboratories. These 700 laboratories vary in size, types of programs and scope of activities. More than 300 have fewer than ten employees and budgets under $300,000 while others have over 2,000 employees with budgets exceeding $200 million.1/

The term "laboratories" used by the Federal Government is a generic term and includes facilities that are actually known as bureaus, centers, facilities, divisions, institutes, activities, offices, museums, stations, research units, or observatories. The Veterans Administration (VA), for example, conducts research in the clinical setting of many of its hospitals, but proper treatment of the patient is their primary function. The U.S. Geological Survey is another case where extensive field offices are necessary to gather and apply data related to their mission. Research for that group is very unlike the work centered around large complex facilities in many defense or space laboratories. Networks of small facilities characterize the National Oceanographic and Atmospheric Administration. Each of these small facilities, including 60 of the VA's clinical research units, is counted separately in the Government's tally of 700 laboratories.

Although it varies greatly from agency to agency, on the average, the Federal laboratories receive about one-half of their sponsoring departments' total R&D funds. About one-half of the R&D funds received by the laboratories are then contracted to universities and industry; the other half is retained by laboratories to carry out roles requiring in-house personnel -- including extensive activities necessary to support contract work. In FY 1983, $10.2 billion of Federal R&D money will be spent on intramural R&D.2/ DOD accounts for $6.0 billion and NASA $1.4 billion. Together they represent 72.5 percent of all intramural R&D.

1/ Federal Laboratory Directory, 1982, Department of Commerce, National Bureau of Standards.

2/ Federal Funds for Research and Development Fiscal Years 1981, 1982 and 1983, National Science Foundation, p. 30.

DOD has 73 laboratories, of which 35 serve the Army, 24 the Navy, and 14 the Air Force. These laboratories employ more than 60,000 people, of which 80 percent are civilian, except the medical and Air Force labs which are 50 percent civilian. The Air Force accounts for 46 percent of DOD's R&D budget. Nearly two-thirds of the annual cash flow is Research, Development, Test and Evaluation (RDT&E) money. The balance of the cash flow comes from procurement funds that are used for the acquisition of initial hardware systems and associated support, particularly product improvements.

NASA operates eight major centers throughout the country. NASA's technical expertise and facilities, such as wind tunnels, are national resources often used by private industry, DOD, the Department of Commerce (DOC), the Department of Energy (DOE), other Federal agencies, and foreign governments. As a result, many of NASA's activities are reimbursed by the using agency. In the FY 1983 budget submission, NASA estimated that 16.5 percent of $1 billion of NASA work will be reimbursable. This work primarily relates to space shuttle operations and space applications.

Methodology

Issue team members interviewed outside advisors as well as 85 key staff members in NASA, the Office of the Secretary of Defense, the Defense Advance Research Projects Agency, former DOD officials, the National Academy of Sciences, the National Science Foundation, the American Association for the Advancement of Science, the General Accounting Office, DOC, Office of Management and Budget (OMB), and other Federal agencies.

Issue team members visited ten DOD laboratories and five NASA centers to gain a better understanding of Federal research facilities and programs. The DOD laboratory site visits included:

- o Night Vision and Electro-Optics Lab, Fort Belvoir, VA;
- o Mobility Equipment R&D Command Laboratories, Fort Belvoir, VA;
- o Harry Diamond Lab, Adelphi, MD;
- o Combat Surveillance and TGT-Acquisition Lab, Fort Monmouth, NJ;

- Aviation R&D Laboratories, Moffet Field, CA;
- Naval Medical Research, Bethesda, MD;
- Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD;
- Medical Bioengineering R&D Labs, Fort Detrick, MD;
- Army Institute of Dental Research, Washington, DC; and
- Walter Reed Army Institute of Research, Washington, DC.

NASA installations visited include:

- Goddard Space Flight Center, Greenbelt, MD;
- Langley Research Center, Hampton Bays, VA;
- Ames Research Center, Palo Alto, CA;
- Marshal Space Flight Center, Huntsville, AL; and
- Johnson Space Center, Houston, TX.

Laboratory directors and professional staff members were interviewed during these visits. In addition to these personal contacts, the issue team analyzed numerous relevant published background documents.

Findings

Based on Task Force interviews, laboratory managers support the development of "centers of excellence." The concept of centers of excellence, utilized more and more, involves the concentration of efforts to pursue research in a given area and centrally locate the resources to perform that research. This concept recognizes that some critical mass of resources is required to conduct first-rate research programs. Along the same lines, increased coordination among R&D laboratories has been cited as desirable to avoid excessive program overlap. DOD is emphasizing joint and cross-Service programs to maximize the benefits of R&D investment. An Office of the Assistant for Directed Energy Weapons has been established to coordinate the efforts of the Services and defense agencies in this specific program area. A concerted effort to reduce duplication of effort and enhance productivity is being made.

NASA is already using the concept of centers of excellence. Each center has a specific set of goals, which has permitted the avoidance of nonproductive R&D overlap among centers. Each center concentrates its efforts on specific areas of expertise.

There is no systematic ongoing process for evaluating R&D laboratories. Each Federal laboratory and its sponsoring agency generally have procedures to review and evaluate the efforts in the laboratory on an annual basis. However, these reviews do not generally cover the scope and merit of the science and programs being conducted in the laboratory. DOD, in particular, has experienced problems in this area. Each Service has its own procedure for evaluating R&D programs and laboratories. The Joint Deputies for Laboratories Committee is a notable attempt at an overall evaluation of the laboratories, but most similar efforts have not been totally effective. In a recent review of DOD laboratories conducted by the Under Secretary of Defense for Research and Engineering (USDRE), 3/ the establishment of an effectiveness review process for the laboratories was recommended, reiterating the need for a systematic, ongoing process.

The current method of appropriating laboratory funding has resulted in indecision and uncertainty concerning funding well into the fiscal year for which the funds are needed. As described in R&D 2, R&D Management and the Budget Process, many aspects of the budget process impede effective management of the R&D labs. These problems preclude a normal planning process and have a negative effect on the R&D work of the laboratories. It is highly doubtful that the problem of Congressional delays and dragging out of funding appropriations will go away in the near future. Multiyear procurement by the laboratories of material and services would, however, provide more efficient planning and execution of the R&D process. In addition, more flexibility of the laboratory directors to allocate funds within their laboratories would help alleviate the problem through more efficient management and flexibility of action.

Staffing levels for Federal R&D laboratories have steadily decreased over the past ten years. The DOD Laboratory Management Task Force, composed of a broad array of senior level representatives from within DOD, reported that manpower ceiling reductions have been the greatest single factor negatively affecting the contribution of laboratories over the past 15 years. In the past decade, the Army laboratories were reduced in size by more than one-third, with reductions occurring every year. 4/

3/ Dr. Robert J. Hermann, USDRE Independent Review of DOD Laboratories, March 22, 1982.

4/ DOD, Report of the DOD Laboratory Management Task Force, July 1980.

Most DOD personnel interviewed said that the ceiling on civil service salaries made it difficult to hire or retain top civilian researchers. Federal laboratories report a gradual loss of technical personnel to industry. Furthermore, entry level salaries are not sufficiently competitive with private industry to attract the top college graduates.

A large portion of the Government's aging research facilities have suffered deterioration and are in need of modernization. The current annual investment in facilities and equipment is rapidly becoming inadequate for effective mission performance. Many DOD facilities that the Task Force visited are old and becoming inadequate for current use. Some facilities, which are several decades old but have received reasonable modernization through the years, remain highly useful. Others, however, have become or are becoming marginal in their utility.

The equipment in these facilities is in a similar state. In some instances these tools are merely old. In other instances they are outdated and inadequate, not because of age, but because of the rapid growth of technology and mission requirements.

This was an issue raised by most of the laboratory directors interviewed and noted in published studies. Many DOD laboratories are inadequately equipped primarily because the Services principally fund ongoing, analytical programs and do not make adequate provision for general purpose and technical equipment needs. The outdated equipment in the laboratories is costly to maintain and wastes manpower. As a result, productivity suffers. These facilities and equipment are an essential element of the work environment and as a consequence greatly affect the productivity of the laboratories. Based on Task Force interviews, the decline in facilities could seriously jeopardize the abilities of the laboratories to meet mission challenges. A review of DOD laboratories conducted by USDRE in 1981 concluded that many of the DOD laboratory facilities are substandard, inadequate, obsolete, or energy deficient and need to be updated. 5/

The designation of a facility as a Federal research and development laboratory is broadly and generically applied to a variety of Government-sponsored activities. There are over 700 facilities designated Federal R&D laboratories currently in operation. A number of these facilities are small and engaged in what would be more

5/ Dr. Robert J. Hermann, *op. cit.*

properly described as data gathering or monitoring functions, not basic or applied R&D. The U.S. Geological Survey, for instance, operates an extensive system of field offices necessary to gather and apply data related to their mission. Another example is the VA, which operates 60 "R&D laboratories," each with ten or more personnel primarily engaged in studying problems arising during the care of veteran patients. These facilities are in sharp contrast to more traditional R&D laboratories. The ten largest laboratories, for instance, each employ a staff of more than 5,000 personnel. Overall only 388 of the 700 R&D laboratories have a staff of ten or more employees. As a portion of the budget, those labs with 100 or fewer personnel account for only 11 percent of the total operating costs for Federal R&D labs (see Exhibit II-9 on the following page).

Federal research and development laboratories are exempt from the provisions of A-76. In the March 29, 1979 version of Circular A-76, R&D was exempted pending development of criteria for determining which R&D work was Governmental and which was commercial activity subject to A-76. The proposed and final revisions exempt R&D entirely from the requirements of the Circular. However, several commercial activities in support of R&D are subject to the provisions of the Circular.

Conclusions

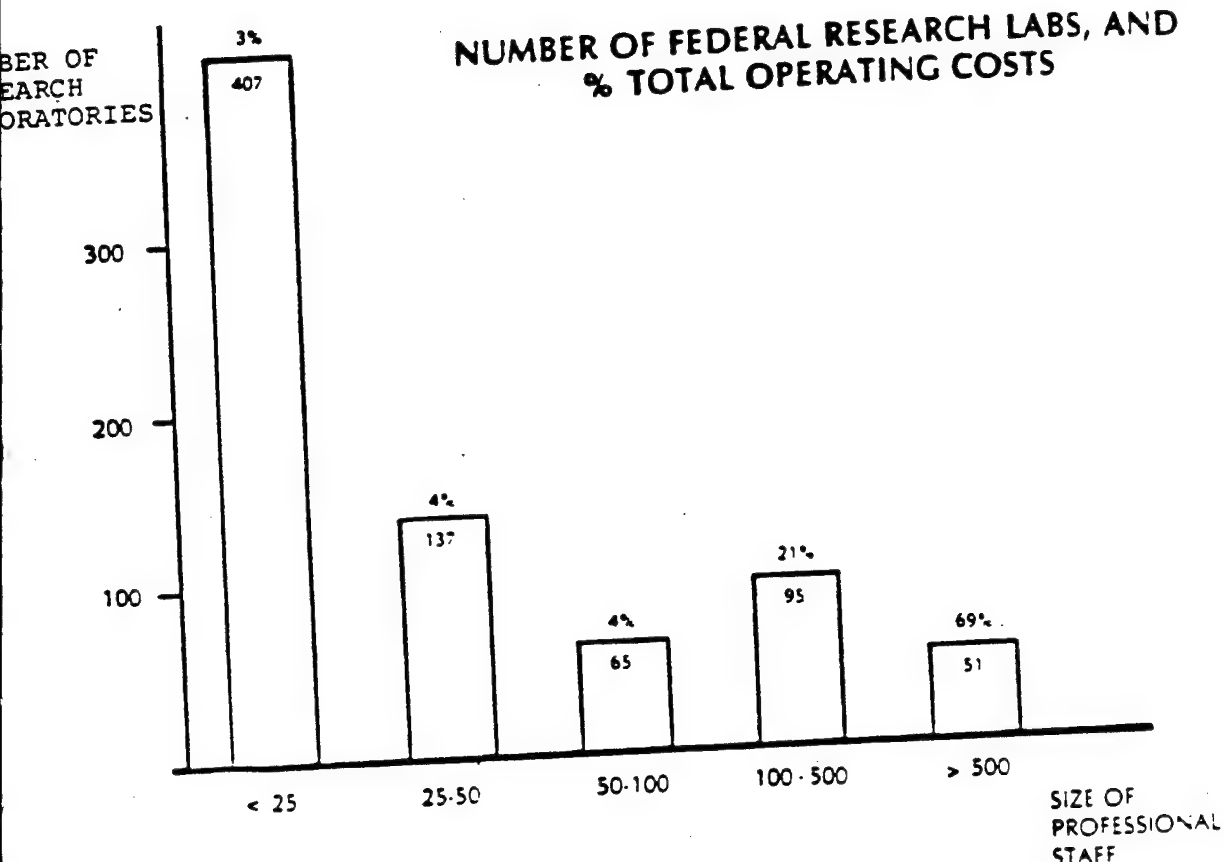
The development of centers of excellence for research should continue. The concentration of resources permits the creation of the critical mass necessary to provide effective research. The trend -- a positive one -- within DOD and NASA is toward more concentration of R&D efforts.

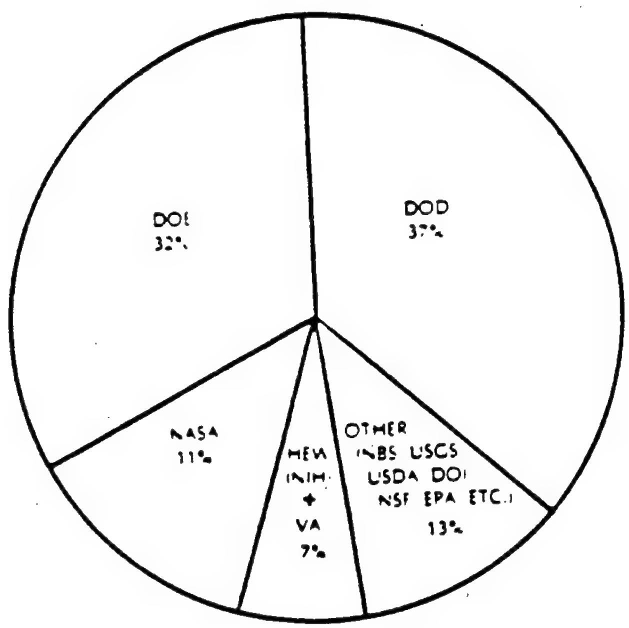
Consideration should be given to consolidating selected Federal R&D laboratories to achieve efficiencies. Based on findings from other PPSS Task Forces, there are R&D laboratories that could benefit from consolidation. This Task Force did not examine this issue in depth and believes that further study is required to determine the potential cost savings and benefits to be derived from consolidating selected Federal R&D laboratories.

In addition to looking at the laboratories for possible consolidations, the 700 Federal laboratories should

[Exhibit II-9 on the following page]

Exhibit II-9





% TOTAL RESEARCH LAB OPERATING COSTS, BY AGENCY

SOURCE: House Appropriations Committee Report, "Utilization of Federal Labs," U.S. GPO, 1978.

be evaluated to determine which ones are actually conducting research and development and classify only those as R&D laboratories. Those facilities that clearly do not conduct actual R&D should be reclassified as to their actual function. This would preclude the broad application of regulations and legislation to facilities with very different sizes, facilities, and missions.

The current exemption of R&D from application of OMB Circular A-76 is not justified. There remain areas of R&D where the private sector would be well suited to conduct work that is now done by Federal laboratories at lower cost. Monitoring and testing functions conducted by many of the small facilities sponsored by the Environmental Protection Agency, National Oceanographic and Atmospheric Administration, U.S. Geological Survey, and others are prime examples of areas where contracting out could save significant amounts of money.

The cost of financing R&D is rapidly increasing for the Federal laboratories as well as for civilian-owned and -operated facilities. The competition for skilled technical personnel and the complexity and sophistication of modern equipment have made R&D, particularly in the areas of high technology, an expensive undertaking. To control these increasing costs, the most effective and efficient management possible must be applied. Many of the overall management problems that affect the R&D labs are covered in R&D 1 and 2 since these issues have a major impact on the labs.

Based on Task Force findings, the overall quality of facilities, equipment and professional staff in the Federal R&D laboratories is declining, while the technology needed to support today's requirements is becoming more costly and sophisticated. Improved management of resources is required to upgrade the quality of facilities and staff.

The current Federal pay schedules significantly handicap the laboratories in recruiting and retaining well-qualified scientists and technicians. Federal pay rates and policies for personnel in the science and engineering disciplines are not comparable with private sector pay for the same level of work.

Any decline in the quality of R&D facilities seriously jeopardizes the ability of laboratories to meet mission challenges. The lack of modernization of many laboratories inhibits work productivity and slows developments. In addition, these facilities are not able to attract and support the highest quality technical personnel. A modernization program geared toward both updating and replacing as well as anticipating future needs should be instituted to address the problems of aging facilities.

Provisions should be made to replace obsolete equipment on a timely basis. Procurement policies should reflect expedient acquisition of state-of-the-art equipment. Replacement of obsolete equipment with more efficient equipment that is less costly to maintain will result in overall cost savings.

Recommendations

R&D 4-1: Additional centers of excellence for R&D research should be formed. Even though many organizations, including NASA, are utilizing this concept to a greater extent, the formation of additional centers of excellence would result in the following benefits:

- more intensive research on given technologies;
- greater purchasing power for sophisticated equipment;
- reduced duplication of work efforts within given technologies; and
- lower administrative and operating costs through better utilzation of resources.

R&D 4-2: The Executive Branch should form a laboratory program evaluation team. To assure a high level of laboratory effectiveness, a systematic approach for program evaluation is necessary. Evaluating laboratory programs periodically will help reduce the amount of money that is wasted on projects that will not result in substantial benefits for the agency. The evaluation team should consist of internal as well as external experts and should perform a limited review of all Federal R&D labs at least once every five years. A more comprehensive review of the larger key labs shoud be conducted every three years. The following areas should be reviewed:

- program overlap;
- laboratory staffing, facilities and equipment;
- mission and research congruency; and
- technical effectiveness of the laboratories.

Each laboratory will continue to be responsible for conducting annual technical reviews. The periodic reviews will provide a comparison among laboratories and will serve as one basis for program and funding decisions.

R&D 4-3: The Executive Branch should undertake a study to examine the potential benefits of consolidating Federal laboratories. Based on Task Force interviews, there is strong evidence that suggests consolidating selected Federal R&D laboratories can result in substantial cost savings. The Task Force currently has insufficient data to recommend specific laboratories that would benefit from consolidation.

R&D 4-4: Directors of Federal R&D laboratories should be given more control over budget appropriations. Less emphasis should be placed on specifying budget items by object code and more flexibility should be given to laboratory directors in determining how the funds will be utilized. The basic objective of increasing directors' control over the use of funds is improved management of resources. The funds can be utilized in those areas that will most benefit the laboratory.

R&D 4-5: Administrative and legislative actions should be initiated to create, at Government-operated laboratories, a scientific/technical personnel system independent of the current Civil Service personnel system. This action would alleviate to some degree the disadvantages now faced by the Government laboratories to attract, retain, and motivate scientific and technical personnel required to fulfill efficiently and effectively their agency-assigned missions.

R&D 4-6: Establish a set of guidelines which would define what constitutes an R&D laboratory. Reclassify those facilities not meeting the guidelines but now included in the list of 700 "laboratories." These guidelines should include requirements that the facility, as its primary activity, be engaged in basic research, applied research, development, or management of R&D. Those organizations which should specifically be excluded from designation as Federal laboratories are those which are engaged primarily in routine quality control and testing, routine service activities, production, mapping and surveys, information dissemination, etc. This reclassification would take facilities now included in the category of R&D laboratories and place them into a more appropriate category such as monitoring station, sampling facility, medical support facility, etc. This reclassification would open the door to more appropriate application of "R&D laboratory" regulations and requirements.

R&D 4-7: Remove current exemption of R&D from the application of the requirements of OMB Circular A-76. In the March 29, 1979 version of the Circular, R&D was exempted pending development of criteria for determining which R&D work was Governmental and which was a commercial activity subject to A-76. The proposed and final revisions exempt R&D entirely from the requirements of the Circular. However, several commercial activities in support of R&D are subject to the Circular's provisions.

Savings and Impact Analysis

The major benefit to be derived from implementing the Task Force recommendations is improved productivity. Based on Task Force interviews with private sector experts, it is estimated that productivity increases of up to 5 percent could be realized. Since the implementation of these recommendations will also incur costs related to the conduct of the evaluations, modernizing facilities, replacing outdated equipment and hiring additional staff at higher salary levels, the Task Force assumes that only approximately 1 percent of actual net savings will be realized on the Federal laboratory budget. Using the FY 1983 figure for intramural research of $10.2 billion, the savings opportunities would be $102 million in the first year.

Removal of the current exemption of Government R&D from application of OMB Circular A-76 would conservatively allow 5 percent of the current laboratory in-house budget to be contracted out. Again using a conservative estimate, a 10 percent savings on the contracted-out work would be realized. Using a base of approximately $10.2 billion as that portion of the laboratory budget spent in-house, $51 million per year could be saved.

The following savings are estimated based on 1983 budget figures and the current Federal laboratory organization. Reclassification of facilities to define as R&D laboratories only those major installations conducting actual R&D would result in a broader application of A-76 and a small increase in savings.

An analysis of potential cost savings is as follows:

	($ millions)			
	Year 1	Year 2	Year 3	Total
Savings resulting from productivity increase	$102.0	$112.2	$123.4	$337.6
Savings resulting from increased use of A-76	51.0	56.1	61.7	168.8
Total savings	$153.0	$168.3	$185.1	$506.4

Implementation

Implementation of R&D 4-1 (centers of excellence), R&D 4-2 (lab evaluation team), and R&D 4-3 (lab consolidation) requires action by the agencies. Congressional action will be necessary to implement R&D 4-4 (lab directors have more control over budget), R&D 4-5 (scientific/technical personnel system), R&D 4-6 (reclassify facilities), and R&D 4-7 (remove A-76 exemption).

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 5: ADMINISTRATION OF RESEARCH GRANTS TO UNIVERSITIES

Issue and Savings

Can changes in the manner in which the Federal Government administers research grants 1/ to universities: (a) improve Government-university relationships; (b) control the increases that have occurred in indirect cost reimbursement; and (c) provide an improved framework for grant administration?

Revision in the negotiating principles for indirect cost reimbursement 2/ and revised grant administration procedures should result in savings opportunities of $117.2 million in the first year, $128.9 million in the second year, and $141.8 million in the third year. Total estimated savings opportunities over three years are $387.9 million. These savings are, in part, based on assumptions of the results of negotiations between the universities and the Government regarding indirect cost rates. Actual savings to be realized would be determined by these parties.

1/ The Task Force recognizes that the Government funding of research conducted by universities is done by grant or contract with the distinction based in the specificity of the scope of the work. For purposes of the discussion of indirect costs, the form of the funding mechanism is not important since the same cost principles apply to both forms.

2/ The President's Private Sector Survey (PPSS) Department of Health and Human Services - Public Health Service, Health Care Financing Administration Task Force identified this as an area for savings opportunities in the National Institutes of Health (NIH). They recommended that reimbursement for indirect cost be reduced by 10 percent. The R&D Task Force also recognizes this as an area with savings potential. Our approach is slightly different.

Background

Since the 1940s the United States Government has emphasized a policy of funding basic research performed at universities, thus creating a strong research enterprise. As the level of Federal financial support grew, the relationship between the universities and Government became increasingly complex and symbiotic.

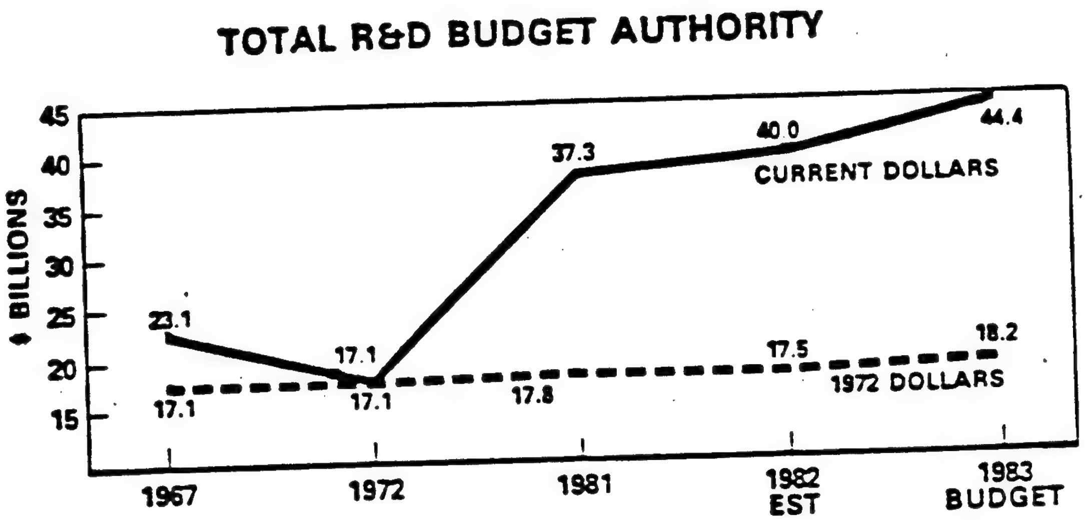
In FY 1983, the level of Federal Government financial support to universities reached $4.7 billion (see Exhibit II-10 on the following page) or about 10 percent of the total Federal research and development (R&D) budget. It continued to account for almost 70 percent of all monies spent on research at universities (see Exhibit II-11). Today, there are approximately 800 colleges and universities conducting Federally sponsored research, 100 of which receive approximately 75 percent of the Federal research funds (see Exhibit II-12).

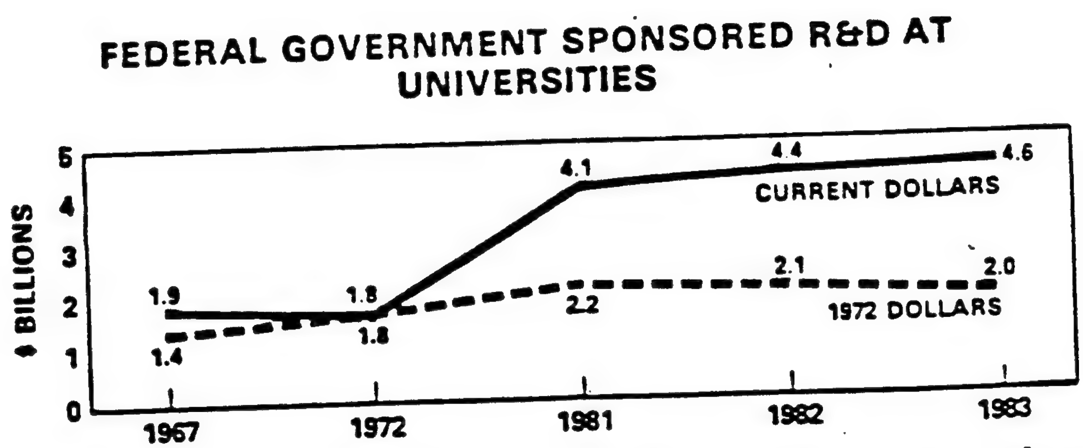
[Exhibits II-10, II-11 and II-12 on the following pages]

EXHIBIT II-10

Trends in Total Federal R&D Budgets and

Federally Supported University Research



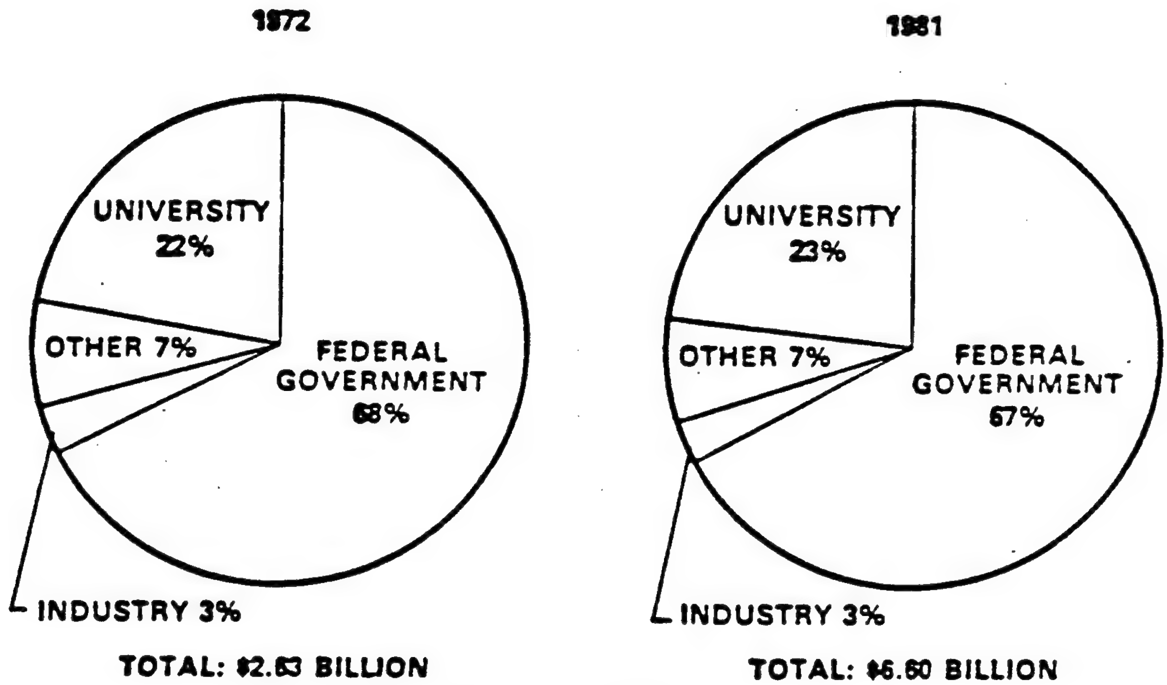


Source: Adapted from American Association for the Advancement of Science (AAAS) R&D Report VII, 1982.

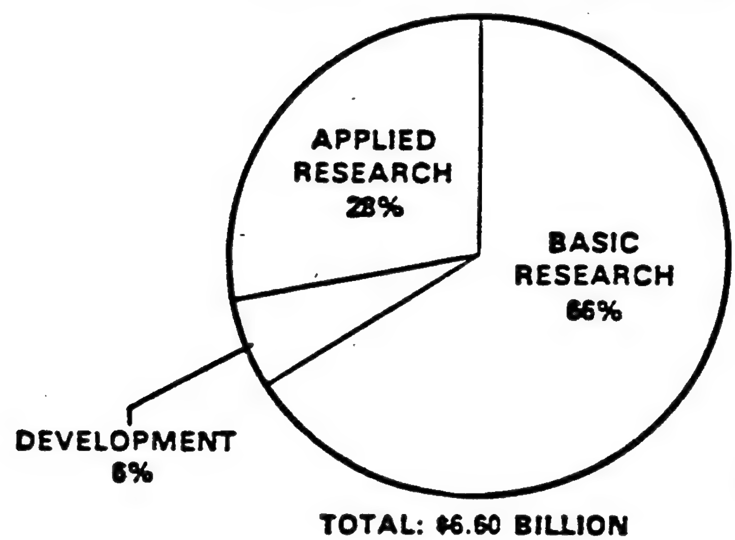
Exhibit II-11

SOURCE OF R&D FUNDING AND TYPE OF R&D PERFORMED AT UNIVERSITIES

SOURCE OF UNIVERSITY R&D FUNDING



TYPE OF R&D PERFORMED BY UNIVERISITIES



SOURCE: AAAS R&D REPORT VII, 1982.

EXHIBIT II-12

Federal Obligations for Research & Development to the 100 Universities and Colleges Receiving the Largest Amounts, By Agency: FY'80 (dollars in thousands)

RANK	INSTITUTION (RANKED BY AMOUNT RECEIVED)	TOTAL	USDA	COM	DOD	ED	DOE	EPA	HHS	INT	NASA	NSF	OTHER*
	TOTAL, ALL INSTITUTIONS	4,155,366	211,809	50,012	555,919	48,022	279,567	76,717	2,025,640	38,750	161,293	607,615	100,022
1	JOHNS HOPKINS UNIVERSITY	239,869	326	330	163,490	468	3,382	1,483	64,459	100	1,260	3,919	652
2	MASS INST OF TECHNOLOGY	141,011	280	2,134	26,859	124	49,138	934	25,163	538	9,904	24,670	1,267
3	STANFORD UNIVERSITY	104,539	305	71	19,567	455	4,743	816	48,069	482	7,160	22,272	599
4	UNIVERSITY OF WASHINGTON	100,567	761	4,083	13,249	2,551	4,565	293	57,727	510	2,202	13,931	695
5	UNIV OF CAL SAN DIEGO	90,703	25	75	11,703	239	1,293	169	32,752	40	9,668	34,739	0
6	UNIV OF CAL LOS ANGELES	87,073	431	143	4,650	1,500	8,976	764	57,459	87	2,715	10,169	179
7	HARVARD UNIVERSITY	83,997	400	303	6,007	174	2,359	1,772	57,987	99	4,079	10,458	359
8	COLUMBIA UNIV MAIN DIV	81,361	0	534	5,250	125	4,106	188	47,846	0	2,005	15,219	6,088
9	UNIV OF WIS-MADISON	80,460	5,201	0	3,797	2,660	7,270	1,048	41,549	275	4,136	14,233	271
10	CORNELL UNIVERSITY	74,761	5,956	18	4,204	14	2,571	1,282	31,391	506	2,161	24,933	1,725
	TOTAL 1ST 10 INSTITUTIONS	1,084,341	13,685	7,691	258,776	8,310	88,403	8,769	464,402	2,637	45,290	174,543	11,835
11	UNIVERSITY OF MINNESOTA	74,739	5,632	610	1,362	1,543	3,133	1,812	49,706	507	1,789	8,379	266
12	UNIVERSITY OF MICHIGAN	71,204	298	2,470	3,051	1,120	3,594	2,359	40,464	0	4,204	10,938	2,706
13	UNIV OF PENNSYLVANIA	70,843	135	226	5,232	423	2,064	349	51,129	15	237	9,106	1,927
14	YALE UNIVERSITY	67,970	130	39	3,840	0	5,128	84	51,423	0	319	7,007	0
15	UNIV OF CAL SAN FRANCISCO	62,581	0	0	330	451	3,250	0	56,756	0	404	1,390	0
16	WASHINGTON UNIVERSITY	52,512	70	50	1,289	0	981	559	45,298	22	1,424	2,803	16
17	UNIVERSITY OF CHICAGO	50,592	135	80	643	556	2,098	0	32,740	0	4,603	9,637	100
18	UNIV OF ILL URBANA	50,332	5,105	0	6,828	2,086	5,680	1,152	9,933	417	1,253	16,611	1,267
19	UNIV OF CAL BERKELEY	49,943	1,841	98	7,890	882	1,743	497	16,098	739	4,310	15,085	760
20	PENNSYLVANIA STATE UNIV	48,279	5,465	444	16,994	4	4,511	455	12,488	1,026	1,646	4,701	545
	TOTAL 1ST 20 INSTITUTIONS	1,683,336	32,496	11,708	304,235	15,375	120,585	16,036	830,437	5,363	65,479	260,200	19,422
21	UNIV OF SOUTHERN CAL	48,198	0	195	11,567	3	1,030	559	27,964	275	1,585	4,839	181
22	UNIVERSITY OF COLORADO	44,460	140	2,931	1,941	1,373	3,399	245	25,461	41	3,354	5,201	374
23	DUKE UNIVERSITY	42,531	139	315	1,727	40	1,220	596	34,759	0	162	3,513	60
24	UNIV OF CAL DAVIS	42,111	4,245	0	476	142	3,886	2,040	14,210	514	123	3,945	12,530
25	UNIV OF NC AT CHAPEL HILL	41,850	365	0	793	540	513	1,909	27,594	247	0	3,536	6,353
26	UNIVERSITY OF ROCHESTER	40,992	60	0	1,769	0	8,921	6	26,258	0	127	3,851	0
27	YESHIVA UNIVERSITY	40,252	0	0	95	155	0	0	39,056	0	0	946	0
28	UNIV OF TEXAS AT AUSTIN	40,223	176	0	15,175	42	5,397	222	7,784	277	3,851	7,119	180
29	NEW YORK UNIVERSITY	39,494	105	0	1,876	451	2,919	850	28,037	41	576	4,629	10
30	OHIO STATE UNIVERSITY	37,034	5,082	373	3,834	1,041	1,347	1,745	12,532	419	1,407	4,904	4,350
	TOTAL 1ST 30 INSTITUTIONS	2,100,481	42,808	15,522	345,488	19,162	149,217	24,208	1,074,092	7,177	76,664	302,683	43,460
31	PURDUE UNIVERSITY	36,487	4,720	0	2,023	112	4,156	268	10,214	600	3,457	8,936	2,001
32	UNIVERSITY OF IOWA	34,598	0	0	1,190	465	248	652	26,197	0	3,615	2,231	0
33	CALIFORNIA INST OF TECH	34,493	8	231	5,640	0	3,618	323	7,212	646	5,284	11,454	77
34	UNIVERSITY OF ARIZONA	33,283	2,419	427	4,331	15	1,443	549	12,714	862	3,399	5,648	1,476
35	UNIVERSITY OF PITTSBURGH	33,181	105	130	2,423	228	1,590	899	22,680	281	948	3,745	152
36	UNIVERSITY OF UTAH	31,828	62	0	1,426	0	3,639	198	20,450	697	918	4,252	186
37	BAYLOR COL OF MEDICINE	31,784	792	72	206	2,551	0	382	27,306	0	257	218	0
38	NORTHWESTERN UNIVERSITY	31,722	100	165	3,297	1,601	1,465	0	15,795	43	222	7,029	2,005
39	CASE WESTERN RESERVE UNIV	31,399	0	242	2,539	300	919	14	22,116	0	1,573	3,614	82
40	OREGON STATE UNIVERSITY	29,577	5,466	4,209	2,399	0	1,054	1,432	5,170	293	800	7,776	978
	TOTAL 1ST 40 INSTITUTIONS	2,428,833	56,480	20,998	370,962	24,434	167,349	28,925	1,243,946	10,599	97,137	357,586	50,417
41	MICHIGAN STATE UNIVERSITY	28,777	5,258	0	1,022	1,803	1,728	1,392	9,777	656	403	6,346	392
42	UNIVERSITY OF MIAMI	27,986	0	50	2,303	98	872	1,933	17,485	10	500	4,725	10
43	GEORGIA INSTITUTE OF TECH	27,833	12	85	19,929	0	1,579	139	1,650	319	1,382	2,217	521
44	TEXAS A & M UNIVERSITY	26,924	7,220	313	2,621	0	1,657	4,333	2,892	599	1,652	5,249	388
45	UNIV ALABAMA BIRMINGHAM	26,835	0	0	168	573	0	0	25,618	0	65	411	0
46	UNIV OF MD COLLEGE PARK	26,367	3,333	598	4,558	224	3,996	529	1,516	158	3,916	7,300	239
47	INDIANA UNIVERSITY	26,334	129	0	908	431	1,144	103	15,344	17	283	7,577	398
48	VANDERBILT UNIVERSITY	25,928	0	0	136	126	335	71	23,284	97	101	1,605	173
49	UNIVERSITY OF FLORIDA	25,134	4,894	98	2,103	153	945	1,125	10,375	221	737	3,745	738
50	BOSTON UNIVERSITY	24,909	0	39	2,049	195	187	84	20,275	0	298	1,682	100
	TOTAL 1ST 50 INSTITUTIONS	2,695,860	77,326	22,181	406,759	28,037	179,792	38,634	1,372,162	12,676	106,474	398,443	53,376

EXHIBIT II-12 (CONT'D)

RANK	INSTITUTION (RANKED BY AMOUNT RECEIVED)	TOTAL	USDA	COM	DOD	ED	DOE	EPA	HHS	INT	NASA	NSF	OTHER*
51	ALBANY STATE COLLEGE	24,024	0	0	0	0	0	0	0	0	0	24	24,000
52	UNIV OF HAWAII-MANOA	23,677	804	0	2,904	0	5,106	543	5,818	293	3,330	4,879	0
53	WOODS HOLE OCNGRPHIC INST	23,415	0	0	8,111	0	1,192	75	0	570	107	13,365	0
54	UNIVERSITY OF VIRGINIA	23,284	350	55	1,418	1,788	2,411	78	13,161	70	481	3,296	376
55	U TEX HLTH SCI CTR DALLAS	22,172	0	0	0	0	0	0	21,929	0	41	202	0
56	COLORADO STATE UNIVERSITY	21,926	4,221	240	2,644	0	1,379	1,299	5,720	1,043	1,152	4,163	63
57	CARNEGIE-MELLON UNIV	21,861	0	0	8,411	132	4,608	126	2,274	382	425	5,416	87
58	CUNY MT SINAI SCH OF MED	21,799	0	0	4	0	0	31	21,037	0	0	472	255
59	UNIVERSITY OF KANSAS	21,718	194	58	597	1,991	283	0	15,276	0	1,442	1,506	371
60	PRINCETON UNIVERSITY	21,423	0	617	2,714	0	3,924	0	5,021	0	2,381	6,702	64
TOTAL 1ST	60 INSTITUTIONS	2,921,159	82,695	23,151	433,564	31,948	198,695	40,786	1,462,398	15,034	115,828	438,468	78,592
61	U TENNESSEE KNOXVILLE	20,572	3,796	50	1,722	50	9,519	92	3,360	49	659	1,233	42
62	UNIV OF TEX CANCER CENTER	20,345	0	0	0	0	0	0	20,098	0	0	247	0
63	ROCKEFELLER UNIVERSITY	19,511	105	0	142	43	732	0	16,330	0	107	2,052	0
64	UNIVERSITY OF CINCINNATI	19,422	140	0	934	0	281	2,243	13,810	21	545	1,448	0
65	LOUISIANA STATE UNIV	19,100	3,132	1,902	1,111	0	1,441	280	9,539	287	201	1,187	0
66	UNIVERSITY OF CONNECTICUT	18,911	775	0	908	0	580	154	14,267	242	246	1,735	4
67	UNIV OF CAL IRVINE	18,426	108	0	2,238	0	2,336	124	9,887	0	248	3,287	198
68	SUNY AT BUFFALO	18,265	0	373	101	0	703	0	13,575	0	66	3,261	186
69	SUNY AT STONY BROOK	18,240	0	0	257	0	1,470	75	9,585	0	857	5,864	132
70	UNIV OF ALASKA FAIRBANKS	17,908	1,267	0	8,447	15	1,079	465	140	414	1,187	4,896	0
TOTAL 1ST	70 INSTITUTIONS	3,111,859	92,018	25,476	449,424	32,056	216,856	44,219	1,872,989	16,047	119,944	463,676	79,154
71	UNIVERSITY OF NEW MEXICO	17,862	80	77	5,848	441	1,926	0	8,048	9	260	1,153	0
72	UNIV OF MD BALT PROF SCH	17,171	5	74	619	0	144	225	15,613	0	0	491	0
73	UNIVERSITY OF GEORGIA	16,885	5,345	66	483	0	2,140	440	3,951	328	107	3,637	308
74	VA POLYTECH INST & ST U	16,711	3,946	39	2,287	47	2,491	548	1,220	700	2,179	2,900	356
75	UNIV OF MISSOURI COLUMBIA	16,380	5,352	85	871	76	354	635	6,887	225	286	1,609	0
76	RUTGERS THE ST UNIV OF NJ	16,130	2,554	26	740	7	307	132	7,279	107	113	4,338	527
77	N C STATE UNIV AT RALEIGH	16,059	5,962	55	911	0	1,602	1,362	2,207	832	580	2,548	0
78	EMORY UNIVERSITY	16,028	0	0	103	1,118	115	206	14,077	0	150	259	0
79	VIRGINIA COMMONWLTH UNIV	15,575	3	0	144	106	122	543	14,136	0	72	319	130
80	BROWN UNIVERSITY	15,334	0	44	1,434	0	1,730	0	5,537	25	698	9,766	100
TOTAL 1ST	80 INSTITUTIONS	3,275,994	115,265	25,942	462,864	33,851	227,787	48,310	1,651,964	18,273	124,389	486,696	80,653
81	UNIVERSITY OF DAYTON	15,314	0	0	14,143	0	373	317	64	0	417	0	0
82	TEMPLE UNIVERSITY	15,217	51	0	110	632	165	173	12,983	5	25	888	185
83	UNIV OF MASS AT AMHERST	14,146	1,894	65	1,748	0	469	521	2,831	213	526	5,879	0
84	UNIVERSITY OF KENTUCKY	13,933	4,842	103	338	175	585	422	5,064	990	252	1,024	138
85	GEORGE WASHINGTON UNIV	13,608	101	30	2,960	1,083	875	289	6,207	0	1,188	856	19
86	GEORGETOWN UNIVERSITY	13,489	86	0	2,035	0	2,271	455	8,050	0	30	519	43
87	WASHINGTON STATE UNIV	13,162	4,081	125	719	0	416	638	2,996	666	155	1,941	1,425
88	UNIV OF RHODE ISLAND	12,907	918	4,040	1,119	20	178	1,418	1,040	73	75	3,965	61
89	UNIV OF VT & ST AGRIC COL	12,035	1,306	0	70	92	268	91	9,616	54	100	438	0
90	UNIV OF ILL MED CTR CHGO	12,017	0	0	0	0	0	173	11,625	0	0	219	0
TOTAL 1ST	90 INSTITUTIONS	3,411,822	128,544	30,305	486,106	35,853	233,387	52,807	1,712,440	20,274	127,157	502,425	82,924
91	U TEX MED BRNCH GALVESTON	11,904	0	0	257	150	0	529	10,304	0	331	283	90
92	WAYNE STATE UNIVERSITY	11,900	0	0	865	0	387	54	8,202	0	76	2,022	294
93	U TEX HLTH SCI CTR HOUSTN	11,282	0	0	52	0	102	760	9,927	0	8	433	0
94	U TEX HLTH SCI CTR S ANTO	11,153	0	0	0	0	0	0	10,984	0	50	119	0
95	UNIV OF CAL SANTA BARBARA	10,946	37	0	1,328	110	812	761	2,631	0	581	4,686	0
96	NEW MEXICO STATE UNIV	10,484	1,529	0	3,612	333	1,715	0	574	491	1,544	998	88
97	SYRACUSE UNIVERSITY	10,263	246	32	3,541	340	312	115	2,927	128	130	2,484	8
98	IOWA ST U OF SCI & TECH	9,913	5,033	0	533	0	109	471	1,336	165	379	1,598	289
99	DARTMOUTH COLLEGE	9,814	26	0	342	0	104	84	7,617	0	240	1,261	140
100	TUFTS UNIVERSITY	9,812	700	0	238	0	455	7	7,857	0	153	402	0
TOTAL 1ST	100 INSTITUTIONS	3,919,293	136,115	30,337	496,874	36,786	237,383	55,508	1,774,799	21,058	130,649	516,311	83,393

* INCLUDES DOT, AID, HUD, LABOR, AND NRC.

Since World War II, Government agencies have used a variety of mechanisms to promote high quality basic research. NIH, for example, was among the first to provide funds to biomedical research. NIH developed a Peer Review System to reach decisions on funding grant applications based upon the highest scientific merit. Under this system, grant applications and results were evaluated by independent researchers familiar with the subject area of the grant in question. The National Science Foundation (NSF) modified NIH's Peer Review System for use in its grant programs. Other agencies, such as the Department of Defense (DOD), extended their existing contract mechanisms to sponsor university research but did not adopt the NIH Peer Review model.

Initially, most award systems appeared to work fairly well; Federal funds were available and competition for funds was not as intense as in recent years. Currently, however, Federal support of university research has actually declined when considered in terms of constant dollars. Furthermore, universities have experienced deteriorating financial positions due to declining enrollments, shrinking endowments, and escalating operating costs.

The financial constraints on both the Government and the universities, as well as differences in goals, have sometimes created controversy and conflicts between the universities and the Government. For example, university desires for flexibility and independence in the performance of research are often difficult to integrate with the Government's need for effective cost reimbursement and accounting procedures.

The Government has attempted to streamline financial reporting requirements for universities through issuance and revision of the Office of Management and Budget (OMB) Circulars A-21 ("Cost Principles for Educational Institutions") and A-110 ("Grants and Agreements With Institutions of Higher Education, Hospitals, and Other Nonprofit Organizations"), among others. Nevertheless, grant accounting and administration have remained relatively complex for a number of reasons, including the Government's need to ensure public accountability and the financial pressures on universities to recoup all of the indirect costs associated with research.

Methodology

The Task Force focused its detailed review for this issue on the research grant activity of three Federal agencies: NSF, NIH and the Office of Naval Research (ONR) in DOD. These three agencies were selected because

they fund about 65 percent of all Federally funded research performed at universities today (see Exhibit II-13 on the following page).

Although the Task Force's in-depth analysis concentrated on these agencies to obtain a more complete understanding of R&D Government-wide, the Task Force reviewed reports of, and conducted interviews in, several other agencies, including:

- White House Office of Science and Technology Policy (OSTP),
- OMB,
- General Accounting Office (GAO), and
- Department of Commerce (DOC).

These discussions and additional analyses of previous studies resulted in a set of preliminary issues that were developed in outline and questionnaire form. These issues were used in follow-up conversations with officials from the University Council on Government Relations (COGR) and the National Academy of Sciences (NAS). The issues were then refined and served as the basis for visits to nine major universities, which together receive about 25 percent of total Federal funds for university research. The issue team interviewed university administrators, department chairpersons and faculty researchers during campus visits.

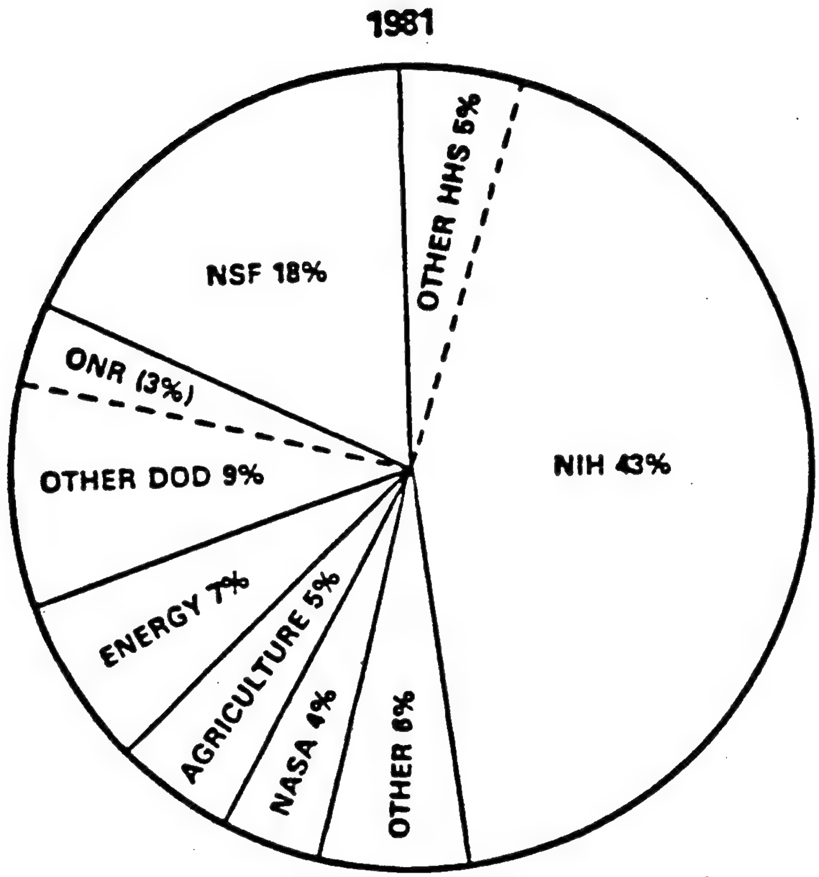
The universities were selected on the basis of their: (a) representation among both public and private institutions, (b) geographic distribution, (c) varying indirect cost rates, (d) difference in cognizant audit agency [Health and Human Services (HHS) or DOD], and (e) difference in Federal funding patterns (i.e., different funding source among NIH, NSF, DOD, Department of Energy, National Aeronautics and Space Administration, and Department of Agriculture). Universities visited were:

- Harvard University,
- Massachusetts Institute of Technology,
- University of North Carolina,
- University of Michigan,
- University of Illinois,
- Northwestern University,
- University of Minnesota,
- Stanford University, and
- University of California.

[Exhibit II-13 on the following page]

EXHIBIT II-13

DISTRIBUTION OF UNIVERSITY R&D SUPPORT AMONG MAJOR FEDERAL AGENCIES



Source: AAAS R&D REPORT VII, 1982.

Findings

The subject of indirect cost recovery is a major source of controversy between the universities and the Federal Government. Although the controversy has heightened in recent years because of attempts by various Federal agencies to control the growth of the rates, its origin goes back to the basic principles involved in calculating indirect costs.

OMB Circular A-21 sets forth the basic principles to be used in determining indirect costs. This Circular has evolved based on the active participation of the universities and the Federal Government. The issue that has been the most troublesome is the calculation of the labor-based indirect cost pools, particularly departmental administration. This cost pool is determined based on a system of payroll distribution, which can take several forms, including:

- a planned, budgeted, or assigned allocation of effort, which is documented and confirmed after the fact;
- an after-the-fact activity record; and
- multiple confirmation records.

Each university applies these principles in a slightly different manner based on its own institutional structure and accounting practices. The following table presents the average indirect cost rate and its components for all universities under the cognizance of HHS.3/

Average Indirect Cost Rate as a Percent of Direct Cost

Operation and Maintenance	11.7%
Departmental Administration	14.5
Sponsored Project Administration	3.0
General and Administration	7.3
Library	1.9
Depreciation/Use Allowance	4.2
Student Services	0.3
Carry Forward	0.7
Total	43.6

3/ The Federal Government uses the single audit concept for universities. Responsibilty for approval and audit of the indirect rate for any one university is assigned either to HHS or ONR as the cognizant agency.

As shown above, the largest indirect cost component is departmental administration, which accounts for time spent in institutional administration, committees and other miscellaneous institutional activities. This is also the most contentious component.

The universities have incurred an increased burden in setting up systems to account for the indirect costs. A 1980 report by the University of California 4/ estimated the cost of complying with OMB Circular A-21 at $900 per award. Other universities which receive $10 to $20 million in grants each year report staffs of three to six people devoted to maintaining the effort reporting system with upwards of 20 people involved in grant administration.

The indirect cost rates that result from the application of the Circular have been increasing in the 1972-1982 time frame as shown in Table II-1 on the following page. In 1972 the average indirect rate as measured as a percentage of direct costs was 25.9 percent. By 1982 the rate had grown to 42.8 percent 5/, a 65 percent increase. Seventy-five percent of this increase occurred in the first half of the period covered (1972-1977) and although the rate of increase has declined in the later half (1977-1982), it is still increasing.

[Table II-1 on the following page]

4/ The University of California, Partnership Between Universities and the Federal Government, January 14, 1980.

5/ The figure used here differs from the 43.6 percent rate shown in the previous table primarily because of the different base to which it is applied. The 42.8 percent is derived by adding the total indirect cost awards to each NIH grant and dividing by the total cost. The 43.6 percent figure applies only to the universities under HHS cognizance (approximately 90 percent) and is weighted on the basis of the total research program of those universities.

Table II-1

HISTORY OF INDIRECT COST RATES PAID BY NIH

	DIRECT COST	INDIRECT COST	TOTAL COST	INDIRECT COST RATE*
72	$ 641,865	$ 166,243	$ 808,108	25.9
73	614,078	185,587	799,665	30.2
74	745,547	240,191	985,738	32.2
75	741,558	258,938	1,000,496	34.9
76**	1,058,466	386,164	1,444,630	36.5
77	961,162	359,140	1,320,302	37.4
78	1,112,973	416,093	1,529,066	37.4
79	1,331,722	512,279	1,844,001	38.5
80	1,463,768	586,306	2,050,074	40.0
81	1,568,995	655,143	2,224,138	41.8
82	1,610,679	689,855	2,300,534	42.8

* Indirect Cost Rate measured on the basis of the ratio of indirect costs to direct costs.

** Includes the quarter (7/76-9/76) involved in the transition from the July 1 - June 30 fiscal year to the October 1 - September 30 fiscal year.

There are basically three causes for this growth.

- o the initiation of indirect cost accounting systems by the universities, as they shifted away from the flat rates that were prevalent in the 1960s (these systems provide for improved identification of costs to be included in the indirect pool);
- o inflation in certain components of indirect cost which is in excess of the inflation in payroll (e.g., energy cost); and
- o a more liberal interpretation of the guidelines which have expanded the indirect cost base.

There has been increasing recognition of this growth in indirect costs, and pressure is growing to control the growth. (The growth in the indirect cost rate is affecting NIH and NSF more than the other agencies since a large percent of their total budget, approximately 75 percent for each agency, is composed of university research grants.) NIH proposed to reduce the reimbursement for indirect costs by 10 percent in FY 1983, but Congress rejected the proposal. The House Committee on Appropriations requested a report on the indirect cost of biochemical and biomedical research from HHS. The report recommended the establishment of a fixed allowance tailored to each institution's historical level.

The reason for the pressure on NIH to control the indirect costs can be seen from Table II-2, on the following page, which shows the average cost of NIH grants in constant dollars from FY 1970 to FY 1982. It was extracted from the report to the House Appropriation Committee. Average indirect costs have increased over the time frame and average direct costs have decreased, particularly since 1972. More and more of the average grant amount is being absorbed by indirect costs. As shown in the last column of the table, the ratio of indirect cost to direct cost has increased from 28.4 percent in 1970 to 44.0 percent in 1982, a 55 percent increase in the rate.

<u>New funding mechanisms and grant administration procedures designed to create more academic institutional flexibility, stability, responsibility and accountability are being evaluated and implemented by NIH, NSF and ONR</u>. Examples include the following:

- o NSF has "redefined" its grant relationship with universities to permit greater flexibility in grant management. Differences between old and

[Table II-2 on following page]

Table II-2

TRENDS IN AVERAGE AMOUNT AWARDED FOR
NIH TRADITIONAL RESEARCH PROJECT GRANTS
FISCAL YEARS 1970-1982 IN TERMS OF 1970 DOLLARS

FISCAL YEAR	TOTAL COSTS - CONSTANT DOLLARS	DIRECT COST - CONSTANT DOLLARS	INDIRECT COST - CONSTANT DOLLARS	INDIRECT COST AS A PERCENT OF DIRECT COST
1970	$36,894	$28,740	$ 8,154	28.4%
1971	39,497	30,395	9,102	29.9
1972	41,817	31,657	10,160	32.1
1973	42,272	31,561	10,711	33.9
1974	44,186	32,781	11,405	34.8
1975	40,890	30,242	10,648	35.2
1976	40,666	29,576	11,090	37.5
1977	42,394	30,757	11,637	37.8
1978	42,889	30,937	11,952	38.6
1979	42,243	30,204	12,039	39.9
1980	41,778	29,619	12,159	41.0
1981	41,651	29,271	12,380	42.3
1982	41,986	29,144	12,842	44.0

Note: Supplements to prior-year awards are excluded in the computation of the average dollars. Constant dollars are based on the biomedical R&D price deflators (FY 1970 = 100). The transition quarter (TQ) which recurred between the end of FY 1976 and the beginning of FY 1977 is excluded. Unobligated balances are distributed between direct and indirect costs.

new procedures are shown in Exhibit II-14 on the following page.

NIH is experimenting with Fixed Obligation Grants (FOGs) and has redefined administrative relationships with grantees in a manner similar to NSF, as discussed above. Under FOGs, once the funding agency has made a tentative decision to make a particular award (e.g., the applicant has completed the current application and peer review procedures), the agency and the prospective performer engage in preaward negotiations to establish agreement on the following: (1) the objectives of the project, (2) the nature and frequency of the technical reports that the performer is to furnish the sponsor as evidence of progress, and (3) the amount and period of the award.

If these negotiations are successful, the sponsor makes the award without any additional requirements for reporting. The sponsor would rely exclusively upon the technical reports to assess whether the performer's accomplishments under the project constitute an acceptable return. Failure by the performer to achieve the mutually agreed upon objectives would weigh negatively in the sponsor's considerations about future funding for that performer's activities, but would not require the withdrawal or return of funds already awarded -- hence the name "Fixed-Obligation Grant."6/

o ONR is experimenting with a Total Business System Review (TBSR) approach that analyzes an institution's financial resources and business management policies. The TBSR emphasizes business management systems review, audit and monitoring rather than grant-by-grant transactions.

[Exhibit II-14 on the following page]

6/ HHS, NIH, Advisory Committee to the Director. Costs for Biomedical Research, Proposed Changes in NIH Authorization and Operations and a Proposal for the Fixed Obligation Grant. Washington, October 1981.

Exhibit II-14

DIFFERENCES RESULTING FROM NSF'S REDEFINITION OF GRANT PROCEDURES

Type of Change	Does the University Have the Authority to Make the Subject Changes Under: Old Procedures	New Procedures
Adjust dollars among budget line items	Yes, except 125% or $500 limit on domestic travel	Yes, without regard to percent or dollars
Approve foreign travel	No	Yes
Approve all permanent equipment purchases	No	Yes
Cover pre-award costs	No	Yes, up to 90 days at grantee risk
Allocate funds among related projects	No	Yes
Allow-no-cost extensions	No	Yes, one time up to six months
Contract for project effort	No	Yes
Change principal investigator	No	No
Change scope	No	No

Source: R.D. Newton, Redefining the NSF-University Grant Relationship, NSF, September 1982.

- NIH and NSF are placing increasing emphasis on multiyear funding of grants in order to achieve greater research program stability. The average NIH grant is for a period greater than three years, and in FY 1982, 20 percent of the grants were for five years. In FY 1982, for the first time, NSF had more multiyear grants than one-year grants.

Conclusions

The Government-university relationship is strained by external and internal factors that inhibit the effective performance of basic research. The current environment is not optimal for attaining either party's mission and goals.

The increased tension associated with the indirect cost question is counterproductive. The time devoted to the question by senior university administrators and senior Government officials is totally unwarranted and is detrimental to their leadership functions. A method should be found to permit the indirect cost to be handled at lower levels in the organization.

New funding mechanisms and recent changes in Government policies are having a positive impact on the conduct and management of university research. The programs listed in the Findings section demonstrate that Federal agencies are making initiatives toward improving the Government-university relationship. Our interviews indicated that these innovative approaches can result in a better grants administration process. NSF's redefined grant program, in particular, has been well received by the universities and the Government.

Recommendations

R&D 5-1: The cognizant agencies should negotiate indirect cost rates that include a fixed rate for the administrative components and relieve the universities of the main portion of the burden associated with effort reporting.

The administrative components of the indirect cost rate (departmental administration, general and administration, and sponsored project administration) are the most difficult components to establish on the basis of documented, objective evidence and further attempts to reach a compromise on acceptable forms of documentation will only create more friction and frustration. Instead fixed rates should be negotiated and the ongoing requirements for documentation of actual rates should be eliminated.

Such an approach should benefit the universities in that it reduces the burden on them and gives them a definite target toward which to manage. To the extent that their actual administrative expenses are less than the negotiated amount, they would benefit. If the actual expenses cannot be controlled within the target, they will have to make up the differences.

The Federal agencies would also benefit because this would help to eliminate the most contentious element in the management of the grant programs. Also to the extent that increases in the administrative components are the cause in the growth of indirect rates, it could be better controlled in this manner.

In operation it would be desirable to establish one rate nationwide. Such a rate would be applied to all universities and would greatly simplify grant administration and record-keeping. This approach may be difficult to implement initially with such a diverse group. As an alternative, it should be possible to negotiate a fixed rate with each university which should be considerably below the current rate since the burdens associated with the documentation of the rate would be eliminated.7/

R&D 5-2: OMB should encourage agencies to implement new funding mechanisms and grant administration procedures.

The issue team recommends that NSF, NIH, DOD, and other Federal agencies continue examining alternative funding mechanisms and grant administration procedures. The most promising programs at an agency should be examined by other agencies for applicability to their own research grants and contracts. OMB should provide this coordination. Greater agency coordination and cooperation is needed to share improvements in Federal support mechanisms. It is recommended that:

- All Federal agencies supporting university research experiment with the NSF redefined grant concept during the next fiscal year. The NSF redefined grant program permits limited grouping of scientifically related projects, allows the university to make certain specified types of budgetary changes on its own, and streamlines grant administration. After each agency's eval-

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7/ We recognize that all of the burden associated with indirect cost would not be eliminated. However, since the accounting for departmental administration is supposed to be the most burdensome, the burden would be considerably reduced.

uation shows adequate university accountability practices, a Government-wide program can be implemented. This program will result in cost-effective university research management and increased researcher productivity.

- NSF and NIH evaluate the ONR short-form research contract approach and adapt it to selected small (e.g., less than $50,000) programs within the next year. The short-form contract streamlines and accelerates research contract award, thereby reducing administrative costs to both the Government and universities. NIH and NSF should evaluate whether ONR's short form can be used with their peer review systems or if an internal review process is more cost-effective.

- All agencies funding university research develop quantifiable goals within the next fiscal year for increased use of multiyear grants. These goals should be explicitly stated in annual budget materials. This activity will improve the stability of ongoing research efforts and encourage the longer term research investigations of more complex problems which may not be amenable to near-term solutions.

- HHS conduct an evaluation of the TBSR being implemented by ONR. TBSR provides oversight consistent with the trend of transferring more responsibility for research grant administration to the institutions. HHS should determine if TBSR could encourage greater research effectiveness without loss of accountability in health research.

<u>R&D 5-3: OMB should develop a simplified, optional method for determining indirect rates for institutions receiving less than $10 million annually</u>.

OMB should work with HHS and ONR to develop and test a simplified method of institutional reporting for universities receiving between $3 million and $10 million in Federal research support each year. Currently, OMB Circular A-21 provides a simplified method for determining indirect rates for universities receiving less than $3 million in Federally sponsored research grants. No such option is available to the universities receiving between $3 million and $10 million. Savings in administrative time could be achieved for both universities and the Government without serious degradation of the information needed for program management. Although there are about 700 universities (88 percent) with less than $10 million a year in research funds, they receive only 20 percent of this total.

Savings and Impact Analysis

The Government has invested more than $100 billion in universities during the past 35 years to build the world's finest basic research enterprise. The technological prominence that the United States gained as a result of this investment must be safeguarded. Recent years have been characterized by minimal real growth or actual decline in support of university research. The Task Force believes that attention should be focused on how to optimize the conduct of research through improvements in environment, systems and research management rather than by reducing funding for R&D.

A savings and impact analysis for each recommendation follows:

R&D 5-1: It is anticipated that the negotiation of the administrative components would result in lower costs to the Government for the existing base of university research. The reduction in the university burden associated with the documentation of departmental administration and the elimination of that controversial part of the problem should result in a lower average rate.

There is no basis to predict the actual reduction that would occur in the indirect rate when the recommendations are implemented. The rates to be set are to be negotiated between the universities and the Government and the results of these negotiations cannot be anticipated. In order to compute savings, it will be assumed that the administrative components would be reduced an average of 3 percent. The 3 percent assumption is based on a reduced burden associated with effort reporting, a reduction in other accounting requirements, and the improvements in the relationship that should develop.

The university research budget is currently $4.7 billion. Using an average indirect rate of 43.6 percent, the direct labor component of the $4.7 billion is $3.273 billion ($4.7 billion divided by 1.436). Anticipated savings at this level would be $98.2 million ($3.273 billion x 0.03) or 2.1 percent of the $4.7 billion research grant award. It should be noted that the actual savings to be realized would be set by the university - Government negotiations. Also these savings may or may not result in reductions in the R&D budget since these "administrative savings" could be deployed to increase direct research funds allocated to university research.

R&D 5-2: If the new funding mechanism described in R&D 5-2 were introduced and the suggested changes in reporting requirements made, agencies could save at least $19 million the first year. This figure was derived from estimates the Task Force obtained from Federal agencies and from seven public and private universities that used the NSF redefined grant on an experimental basis. The institutions' estimated savings ranged from negligible to approximately 1.5 percent of the total Federal funds received by the university. Most frequent estimates were in the range of 0.5 to 1.0 percent. These savings to the university would be passed back to the Government through reductions in grant amounts. The following estimates are used to calculate the total savings:

- 1983 annual Federal support of universities = $4.7 billion.
- Less $ 0.9 billion already under the NSF model (at NSF) = $3.8 billion.
- $3.8 billion x 0.5% = $19.0 (low estimate)
- $3.8 billion x 1.0% = $38.0 million (high estimate).

We have conservatively estimated that savings will be at the lower end of this range. These savings result from reduction of administrative overhead and do not overlap with the savings from R&D 5-1.

Another important benefit is greater efficiency in the performance of research. University researchers and grant administrators enthusiastically support the changes included in the recommendation, and the university-Government relationship is bound to improve.

R&D 5-3: A simplified reporting system would reduce Federal and university administrative costs and strengthen Federal oversight.

No savings are quantified for this recommendation.

Summary: The chart below summarizes the net savings for this issue, assuming 10 percent annual inflation.

Summary of Savings
($ millions)

Recommedations	Year 1	Year 2	Year 3	Total
R&D 5-1	$ 98.2	$108.0	$118.8	$325.0
R&D 5-2	19.0	20.9	23.0	62.9
R&D 5-3	NQ	NQ	NQ	NQ
Total	$117.2	$128.9	$141.8	$387.9

(NQ = Not Quantified)

Implementation

All recommendations can be implemented under existing agency authority.

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 6: RESEARCH PROGRAM REPORTING

Issue and Savings

Can unnecessary research project redundancy be reduced by use of an automated central data file as part of the research and development (R&D) project initiation and ongoing management?

The Task Force conservatively estimates that implementation of a centralized data base containing records of all non-classified, Federally funded, completed and ongoing R&D projects will reduce unnecessary program redundancy in basic and applied research by a minimum of 0.5 percent in the second year and by 1.0 percent by the third year. This will result in net savings of $71 million in the second year and $158.5 million in the third year. After accounting for the $4.0 million in start-up costs, the three-year total net savings would be $225.4 million.

Background

The need for a central depository to control and disseminate information on completed and ongoing Federally funded R&D has been considered for nearly four decades. It is estimated that in FY 1983 the Federal Government will spend $43.0 billion on R&D projects conducted by the Federal Government, industrial firms, universities and colleges, and other nonprofit institutions (excluding $1.3 billion expenditures on R&D facilities).

In addition, numerous areas of R&D involve more than one agency or multiple subdivisions of a single agency. Table II-3, on the following page, shows levels of cross-agency and cross-subdivision activity in various categories of research in the physical and environmental sciences. For example, there are 22 independent agencies and Executive agency subdivisions involved in chemistry-related research at a funding level of $532.8 million for FY 1983.

[Table II-3 on following page]

Table II-3

FEDERAL OBLIGATIONS FOR RESEARCH IN PHYSICAL AND ENVIRONMENTAL SCIENCES, BY AGENCY AND DETAILED FIELD OF SCIENCE: FISCAL YEAR 1983 (ESTIMATED)

(THOUSANDS OF DOLLARS)

AGENCY AND SUBDIVISION	PHYSICAL SCIENCES					ENVIRONMENTAL SCIENCES				
	TOTAL	ASTRONOMY	CHEMISTRY	PHYSICS	PHYSICAL SCIENCES NEC	TOTAL	ATMOSPHERIC	GEOLOGICAL	OCEANOGRAPHY	ENVIRONMENTAL SCIENCES NEC
TOTAL, ALL AGENCIES	2,846,294	386,078	532,818	1,762,371	165,027	1,097,700	390,248	369,813	252,752	84,887
DEPARTMENTS										
DEPARTMENT OF AGRICULTURE, TOTAL	68,023	-	64,250	3,773	-	13,178	5,112	8,066	-	-
AGRICULTURAL RESEARCH SERVICE	53,409	-	50,770	2,639	-	3,007	2,192	815	-	-
COOPERATIVE STATE RESEARCH SERVICE	10,021	-	10,021	-	-	1,255	1,255	-	-	-
FOREST SERVICE	4,593	-	3,459	1,134	-	8,916	1,665	7,251	-	-
DEPARTMENT OF COMMERCE, TOTAL	1,117,386	948	115,699	993,766	6,973	133,478	60,762	38,429	29,215	5,072
ENERGY RESEARCH AND TECHNOLOGY ADMIN 1/	1,071,462	390	102,678	961,421	6,973	72,095	22,983	36,011	8,029	5,072
NATIONAL BUREAU OF STANDARDS	39,647	558	12,141	26,948	-	377	-	377	-	-
NAT'L OCEANIC & ATMOSPHERIC ADMIN	6,277	-	880	5,397	-	61,006	37,779	2,041	21,186	-
DEPARTMENT OF DEFENSE, TOTAL	807,695	16,946	128,030	513,477	149,242	230,291	91,769	41,922	77,993	18,607
DEPARTMENT OF THE ARMY	139,310	-	58,451	52,126	28,733	23,529	13,134	8,734	437	1,224
DEPARTMENT OF THE NAVY	251,237	11,029	35,363	186,750	18,095	90,810	11,670	6,151	61,016	11,973
DEPARTMENT OF THE AIR FORCE	97,845	5,917	33,916	55,140	2,872	51,405	43,076	8,329	-	-
DEFENSE AGENCIES	319,303	-	300	219,461	99,542	64,547	23,889	18,708	16,540	5,410
DEPT OF HLTH & HUMAN SERVICES, TOTAL	85,615	-	76,821	8,794	-	-	-	-	-	-
ALCOHOL, DRUG ABUSE & MENTAL HLTH ADMIN	2,648	-	2,648	-	-	-	-	-	-	-
NATIONAL INSTITUTES OF HEALTH	82,967	-	74,173	8,794	-	-	-	-	-	-
DEPARTMENT OF THE INTERIOR, TOTAL	13,673	-	10,070	1,740	1,863	147,262	6,471	126,083	12,178	2,530
BUREAU OF LAND MANAGEMENT	-	-	-	-	-	250	-	-	-	250
BUREAU OF MINES	6,600	-	4,800	-	1,800	4,900	-	3,600	-	1,300
BUREAU OF RECLAMATION	-	-	-	-	-	4,473	4,323	-	150	-
GEOLOGICAL SURVEY	6,940	-	5,200	1,740	-	134,242	-	122,214	12,028	-
NATIONAL PARK SERVICE	63	-	-	-	63	3,022	2,148	69	-	805
OFFICE OF THE SECRETARY	-	-	-	-	-	175	-	-	-	175
OFF OF SURFACE MINING RECLAMATION & ENFORCEMENT	70	-	70	-	-	200	-	200	-	-
DEPARTMENT OF JUSTICE, TOTAL	200	-	-	-	200	-	-	-	-	-
DRUG ENFORCEMENT ADMINISTRATION	200	-	-	-	200	-	-	-	-	-
DEPARTMENT OF STATE, TOTAL	-	-	-	-	-	140	-	-	-	140
DEPARTMENTAL FUNDS	-	-	-	-	-	140	-	-	-	140
DEPARTMENT OF TRANSPORTATION, TOTAL	94	-	94	-	-	135	78	57	-	-
FEDERAL HIGHWAY ADMINISTRATION	94	-	94	-	-	135	78	57	-	-
DEPARTMENT OF THE TREASURY, TOTAL	1,781	-	392	249	1,140	-	-	-	-	-
BUREAU OF ENGRAVING AND PRINTING	1,781	-	392	249	1,140	-	-	-	-	-
OTHER AGENCIES										
ENVIRONMENTAL PROTECTION AGENCY	36,884	-	36,884	-	-	3,521	873	2,273	375	-
FEDERAL EMERGENCY MANAGEMENT AGENCY	4,609	-	90	4,519	-	181	181	-	-	-
INTERNAT'L DEV COOPERATION AGENCY	-	-	-	-	-	160	-	-	-	160
AGENCY FOR INTERNAT'L DEVELOPMENT	-	-	-	-	-	160	-	-	-	160
NATIONAL AERONAUTICS & SPACE ADMIN	413,407	291,980	5,900	110,402	5,125	279,172	124,212	73,934	24,028	56,998
NATIONAL SCIENCE FOUNDATION	284,574	67,551	90,888	125,651	484	286,422	100,666	76,332	108,044	1,380
SMITHSONIAN INSTITUTION	8,653	8,653	-	-	-	3,595	104	2,592	899	-
TENNESSEE VALLEY AUTHORITY	3,700	-	3,700	-	-	-	-	-	-	-
US ARMS CONTROL & DISARMAMENT AGENCY	-	-	-	-	-	165	20	125	20	-

1/ THE 1983 BUDGET PROPOSED THAT THE DEPARTMENT OF ENERGY BE REPLACED BY THE ENERGY RESEARCH AND TECHNOLOGY ADMINISTRATION WITHIN THE DEPARTMENT OF COMMERCE.

SOURCE: NATIONAL SCIENCE FOUNDATION

Given the size of the Federal R&D budget, the dispersion of R&D projects among a variety of investigators, and the degree to which multiple agencies fund or perform R&D in similar areas, there is substantial potential for redundant and costly program funding and inefficient technology transfer without a centralized information management and control system.1/ There have been efforts to provide a central data bank of completed and ongoing R&D projects in recent years.

Smithsonian Science Information Exchange (SSIE) -- SSIE evolved from the Medical Sciences Information Exchange established in 1949. SSIE collected data concerning research planned or in progress from research support agencies and individual investigators. Research information submitted to SSIE was registered on a single page, Notice of Research Project, which included:

- o the name of the granting agency,
- o names and addresses of principal and associate investigators,
- o location of work,
- o title,
- o a 200-word summary of technical detail, and
- o the level of effort.

The information was then coded and indexed to visible (i.e., microfiche) and electronic data processing files. Access to R&D project information was restricted to research investigators associated with recognized research institutions and research directors and administrators of cooperating Government agencies.2/

By FY 1981, its last full year of operation, Federal appropriations for SSIE were over $2 million. The Office of Management and Budget (OMB) had proposed to transfer the service to the Department of Commerce (DOC) in that year. However, Congress withheld approval of the transfer.

1/ Clearly, there are many situations where redundancy in R&D is both required and desirable. Frequently, a sponsor will want to initiate similar studies so that more than one group is addressing a significant problem. In other instances, sponsors will want work repeated for verification, training, or sensitivity studies. This issue, however, concerns project redundancy beyond that which is desired and necessary.

2/ Smithsonian Science Information Exchange Annual Report, 1981.

During FY 1982 budget proceedings, it was decided not to transfer the SSIE service to DOC; rather, it was recommended that funding for SSIE be cut back for each subsequent fiscal year, and that the organization become fully self-sustaining by FY 1985. The SSIE Advisory Council determined that the service could not become a viable self-sustaining entity without a sufficient lead-time at full Federal funding in order to develop a solid revenue base through marketing and product improve- ment programs. Therefore, SSIE opted to close operations in FY 1982. By the time SSIE phased out, its data base contained 300,000 citations, including non-Federal and foreign R&D, and was being updated at a rate of 100,000 new and ongoing R&D projects per year. Services provided or contemplated by SSIE prior to its demise included the following:

- administrative indexes consisting of alphabetical entries of all R&D citations by performing and supporting organization, investigators' names, and geographical location of performing organizations;

- hierarchical subject indexes of ongoing research;

- research information packages geared to specific types of research or clientele; and

- data base access both through on-line commercial vendors and directly through SSIE.

National Technical Information Service (NTIS) -- NTIS is a self-sustaining organization, under the auspices of DOC, with sales revenues of over $19 million in FY 1982. The organization was established in 1970, at which time the Clearinghouse for Federal Scientific and Technical Information was abolished and its functions transferred to NTIS.

The NTIS Bibliographic Data Base now serves as the central source for the collection and dissemination of non-classified Government-sponsored R&D and engineering reports submitted on a voluntary basis. The data base currently contains about 800,000 citations dating back to 1964 and is updated biweekly at a rate of about 65,000 new citations per year. Users access the NTIS data base through commercial on-line retrieval services or directly from NTIS.

The NTIS data base currently does not contain information on new and in-progress Federal R&D projects. It had been proposed that by FY 1981 NTIS would begin to absorb fully the functions and capabilities of the SSIE data base. A feasibility study had estimated the cost of the merger,

including the expansion of the NTIS data base to accommodate SSIE's project files and conversion of the files, to be about $2.0 million. These systems were merged in FY 1983.

In 1983, NTIS developed plans with the Office of Science and Technology Policy (OSTP) to provide NTIS users with a central source of information on current Federal R&D projects. Under the arrangement, OSTP will coordinate the collection of current R&D project information. The information will then be compiled by NTIS and offered as an on-line commercial information service to the agencies affiliated with NTIS.

Methodology

The Task Force interviewed key staff personnel from OMB, NTIS, Department of Defense (DOD), National Aeronautics and Space Administration, National Institutes of Health (NIH), U.S. Department of Agriculture, General Accounting Office (GAO), and other Federal agencies, as well as private sector staff with experience in both research control and information systems. In addition, literature sources related to Government R&D were reviewed.

Findings

Interviews and studies of several large Federal research divisions showed a significant number of research projects that appear to be duplicative of other projects. The Task Force did not study the potential redundancy of individual projects. However, these cases were identified during interviews and site visits. For example, the different military Services have undertaken to develop protective clothing and gear independently of one another. Each conducts separate studies of materials acceptability, reaction, etc. In another example, several agencies are conducting parallel research on genetic engineering without cross-consultation. In a third example, at least three agencies are studying myotoxins without joint discussions of needs, funding and future plans. Finally, a 1982 GAO report discussed the funding of 11 Federal agencies to conduct research in the National Marine Pollution Program and the need for better coordination among the several agencies involved in that area of research (see Table II-4 on the following page).

[Table II-4 on the following page]

Table II-4

National Marine Pollution Program Funding by Agency and Categories in FY 1981

($ thousands)

Federal agencies	Marine Waste Disposal	Marine Mining	Marine Energy	Marine Transportation	Accidental Discharges	Coastal Land Use	Information Collection and Interpretation	Cumulative Effects	Total
Department of Agriculture						$ 196			$ 196
Department of Commerce	$ 5,915	$ 602	$ 68	$ 162	$ 1,561	6,487	$3,112	$7,833	25,740
Department of Defense	5,704	386		3,900		126	2,018	257	12,391
Department of Energy	6,700		4,100		100	5,523	151	6,162	22,736
Department of Health and Human Services	715					687		3,154	4,556
Department of the Interior		40,618			528	5,392	2,160	2,500	51,198
Department of Transportation				339	1,051				1,390
Environmental Protection Agency	6,378	3,816			3,405	6,488	3,009	8,604	31,700
National Aeronautics and Space Administration							500		500
National Science Foundation								18,765	18,765
Nuclear Regulatory Commission	—	—	—	—	—	600	100	300	1,000
Total	$25,412	$45,422	$4,168	$4,401	$8,645	$25,499	$11,050	$47,575	$172,172

1/Funding Estimates as of June 1, 1981.

Source: GAO, Need to Strengthen Coordination of Ocean Pollution Research, July 14, 1982.

In an interview with a vice president of a highly respected private sector research firm, he reported that in his laboratories roughly 10 percent of the projects under way at any one time could be unnecessarily redundant in the absence of positive management action. In his view, many researchers have a concurrent need to achieve the same objective. Several will start similar studies to gain the desired information. At least once each year in that firm, the director actively searches out project redundancy and institutes a review to uncover unwarranted duplication. The firm then acts to consolidate its research efforts and eliminate redundancy.

Numerous interviews at key R&D agencies within the Federal Government revealed that research managers are concerned that there is no central source of information from which knowledge gained during previously conducted, Federally funded programs is available. As a result, new projects are often started in various agencies without the benefit of experience gained in similar studies conducted elsewhere.

It is currently not possible for an agency to recover information formally and comprehensively from programs of other agencies until publications are made. Some agencies, such as DOD, do not make R&D project information publicly available for reasons of national security. In others, publication usually takes a year or more.

Some agencies, such as DOD's Defense Technical Information Center and the Environmental Protection Agency's (EPA) Office of Toxic Integration, maintain their own R&D project information data bases. However, these are only agency-specific systems without interface to other agency and NTIS data bases.

Currently, there is no central data base capable of providing ready access to all unclassified, new, ongoing, and completed Federally funded R&D. The NTIS data base currently does not contain records of ongoing Federally funded R&D and only limited records of such projects are expected to be available through commercial vendors in the foreseeable future. In addition, the NTIS data base of completed R&D projects is not comprehensive. A GAO survey of Federal agencies revealed that only 64 percent of the respondent agencies submitted completed R&D project reports to the NTIS data base.3/

3/ GAO, Federal R&D Laboratories -- Director's Perspectives on Management, November 28, 1979.

A review of NTIS user statistics shows that the data base is not extensively used by Federal agencies. Only 10 percent of NTIS customers are Federal agencies, whereas 46 percent are from business and industry; 18 percent are individuals; 13 percent, universities; 11 percent, state and local governments; and 2 percent, other.

Conclusions

The Task Force has reached two conclusions. First, a comprehensive R&D information system needs to be implemented in the Federal Government; secondly, new projects should be initiated only after the sponsor states that a search has been made and that the work is not redundant. This is already a requirement in some Federal R&D divisions such as EPA's Office of Toxic Integration. The information system should be designed such that it may be accessed by any member of the R&D community and is readily accessible by all R&D professionals in the Federal Government.

Research personnel should be able to access easily the data base to retrieve all previous studies on a topic of interest and also to identify significant discoveries in areas of research. As an addendum, the data base should allow for cross-checking in order to eliminate redundancies.

Both the mechanism and the expertise exist within the Federal sector to establish such a system. Not only do individual agencies such as NIH, DOD and EPA have prototypes that have been tested, but the format of the NTIS system provides access key words, access terms and a method for report dissemination.

Recommendations

R&D 6-1: The NTIS data base should be expanded within limits permitted by national security needs. This expansion should include a comprehensive listing with abstracts of all current Government R&D programs, both in-house and contracted, as well as comprehensive information for completed R&D programs.

R&D 6-2: Contribution to and use of the data base by Federal agencies should be made mandatory. Further, it should be the responsibility of every sponsor to provide periodic entries into the data base as interim and final reports become available.

R&D 6-3: Every contract award and grant the Federal Government makes to fund extramural research should include a requirement that contractors and grantees supply

material for the data base in the appropriate format. Contractors and grantees should be considered delinquent, and contracts and grants should be considered incomplete, unless such documents are submitted.

R&D 6-4: Every sponsor of any study, both those conducted within the Federal Government and those conducted in extramural facilities, should state in the document requesting or authorizing the study that (a) a study has been made of the literature or appropriate data bases, (b) the work for which funding is being requested or authorized has not been or is not being carried out, and (c) the study takes into account other work completed and reported.

Savings and Impact Analysis

Annual savings from instituting and implementing a comprehensive R&D data base, as recommended above, will be achieved by a reduction in the funding of undesired or unnecessarily redundant Federal R&D projects. Task Force interviews with key staff and review of representative R&D divisions in both the Federal Government and the private sector revealed that such project redundancy may range from 5 to 10 percent of program funding for basic and applied research. However, in calculating the savings to be realized Government-wide by implementation of its recommendations, the Task Force considered these factors:

- There is redundancy in the Federal R&D budget that is, indeed, warranted.
- A significant portion of the R&D budget consists of programs of a classified nature which would not be included in the proposed central data base (a reliable estimate of the dollar amount, however, is not available).
- There is ongoing research that, even if found unnecessarily redundant, could not be immediately curtailed.
- The process of uncovering areas of redundancy and pinpointing specific projects as unwarranted will require time and careful consideration.

Consequently, the Task Force's calculation of potential savings in this issue conservatively assumes that the level of unwarranted redundant R&D that can be eliminated in the second year of implementation represents 0.5 percent of the total estimated Federal basic and applied research for FY 1983 ($13.3 billion). This percentage is assumed to increase to 1.0 percent by the third year. The Task Force

analysis assumes no savings will be realized and that a start-up cost will be incurred in the first year of implementation of its recommendations. These costs would primarily involve the development of a standardized reporting format and method for all agencies and contractors involved in Federally funded R&D at an estimated first-year cost of $4.0 million. Subsequent annual operating costs are estimated to be $2.0 million. Savings are calculated as follows (figures are inflated 10 percent per year):

Savings Calculations

	($ millions)			
	Year 1	Year 2	Year 3	Total
Savings from Year 1 project reductions (0 x $13.3 billion)	--	--	--	--
Savings from Year 2 project reductions (.005 x $13.3 billion)	--	$ 73.2	--	$ 73.2
Savings form Year 3 project reductions (.01 x $13.3 billion)			$160.9	$160.9
Cumulative gross savings	$ -0-	$ 73.2	$160.9	$234.1
Implementation and operating costs	$ (4.0)	$ (2.2)	$ (2.4)	$ (8.6)
Cumulative net savings	$ (4.0)	$ 71.0	$158.5	$225.5

Implementation

Implementation of the Task Force's recommendations can be done by the agencies involved.

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 7: NASA COST REPORTING

Issue and Savings

Can project management in the National Aeronautics and Space Administration (NASA) be strengthened by expanding the scope and coverage of the systems used to manage NASA resources to include Civil Service personnel?

The Task Force believes that the recommendation presented in this issue will permit NASA to improve the overall management of the agency. No specific savings are attributed to this management improvement.

Background

NASA's budget is divided into three major appropriation accounts:

- Research and Development (R&D) -- funds the study, development and acquisition of space systems to carry out the NASA mission. Of all the funds appropriated in this account, 93 percent are used to contract out the study and development activities.

- Construction of Facilities -- covers the facility planning and construction activities to support NASA operations.

- Research and Program Management (R&PM) -- funds all internal NASA activities including the planning of new space projects; the management of the space projects currently being developed; actual design and development activities on existing space projects; support and management of operational space missions; and the work done in the support and management of the research and development contracts.

Since its inception, NASA has reported its project costs as incremental costs to the agency for conducting a project, i.e., any costs incurred specifically to support a project. All other costs including Civil Service employees and launch, tracking and data acquisition costs within existing capabilities are not considered incremental to any project and therefore are not included in project costs. This type of reporting distorts the true cost picture of any project.

Methodology

In developing this issue, the Task Force conducted interviews at NASA, the Office of Management and Budget (OMB) and the General Accounting Office (GAO) to further define the problem and to attempt to understand fully the background of the issue. These interviews were supplemented by a review of several GAO reports.

Findings

NASA has a well-defined automated system for managing the space projects it undertakes. The primary focus of management is on the contractors responsible for developing the various NASA projects. The extent of NASA internal manpower resources employed on a project and how they are utilized are not specifically included in the management process.

As part of overall project planning, NASA does require an estimate of the internal manpower resources required to complete a project. However, internal project management during the life of a project does not report on the actual utilization of the people, and subsequent planning does not cover these resources except in emergency situations.

These internal resources can be significant on a total project basis. The following table, derived from two separate GAO reports on the subject 1/, shows that the unreported project costs attributable to Civil Service personnel ranged from 13 percent to 34 percent of total project cost. This means that NASA reports on the cost of these projects significantly understate real costs.

Project	GAO Estimate of Costs of Civil Service Personnel as a Percent of Project Costs *
Atmosphere Explorers - C, D, and E	34%
Orbiting Solar Observatory - I	20%
Nimbus G	13%
Space Telescope	20%

* Project costs are used as the base since that is the basic number reported by NASA.

These data apply to total projects. The percentages could be much higher as a percent of project cost on individual components or subsystems. In certain situations the entire subsystem, or a major part, may be developed in-house.

According to the GAO studies, the problem goes beyond the basic development cost. In the case of the Space Telescope, GAO found that NASA was significantly understating the full life cycle costs as well.

	Development Cost	Operation Cost ($ millions)	Life Cycle Cost
NASA estimate	$ 530	$ 600	$1,130
GAO estimate (included Civil Service costs and inflation)	$ 716	$1,473	$2,189

1/ GAO, Need For Improved Reporting and Cost Estimating On Major Unmanned Satellite Projects, PSAD-75-90, July 25, 1975.

GAO, NASA Should Provide the Congress Complete Costs Information on the Space Telescope Program, PSAD-80-15, January 3, 1980.

Another GAO study 2/ criticized NASA for not including "relatively fixed" costs for "Civil Service support; general support costs for launch vehicles, tracking and data acquisitions; or costs incurred by other agencies supporting the projects." Specific examples cited by GAO include:

	Unreported Costs
Space Shuttle	$ 2.3 billion
HEAO A-C	$77.8 million
Mariner Jupiter/Saturn 1977	$47.9 million
Pioneer Venus	$19.6 million

These examples clearly indicate significant costs associated with space projects that are not being covered in the management of the individual projects.

Another estimate of the magnitude of this problem can be developed from the FY 1983 budget. The budget for the total R&PM account is $1.229 billion. If the $176 million budgeted for other services is removed, $1.05 billion would represent the total internal NASA budget for 22,382 full-time equivalent (FTE) employees. The NASA Comptroller's Office estimates that 30 to 50 percent of NASA personnel are currently employed on the various projects.3/ Accordingly, $315 to $525 million of project work is not actively being covered in the project management system.

GAO has repeatedly criticized NASA for not including these costs in the reports submitted to Congress. NASA response to GAO always addresses the following points:

- o The NASA Civil Service staff is a vital national resource necessary to provide a capability but is insensitive to the changes in project requirements. As such, if a project is added or deleted the Civil Service costs will not change.

2/ GAO, Improved Reporting Needed on National Aeronautics and Space Administration Projects, PSAD 77-54, January 27, 1977, p.8.

3/ The remainder of the Civil Service personnel are involved in overall agency management, advanced development and preliminary project planning such as the Space Station.

- There is a need to maintain flexibility in the utilization of the Civil Service staff. When individual projects enter difficult periods, NASA wants the ability to assign staff to the contractor's facility to assist in problem resolutions or to bring a certain aspect of the project in-house for better control.

- The economic costs of a project to the NASA budget should not include the Civil Service costs since these costs would not be avoided if a project were canceled.

Conclusion

Based on our experience in the private sector, the Task Force believes that NASA must expand its project management systems to include the internal resources that are available to it. The 22,000 person-years of effort per year should be controlled to the same degree as the R&D monies in pursuit of NASA's mission. This does not necessarily imply that the total resource level would change as a result of individual project decisions. It does mean that decisions should be made on the basis of current and planned project work load.

Recommendation

R&D 7: NASA should expand its project management systems to cover all resources available to it. The $1.2 billion made available to NASA in the research and program management account is just as important from a management perspective as the $5.3 billion in the R&D account.

Savings and Impact Analysis

No specific savings are estimated for this issue since it is primarily a management improvement issue. Certainly, economies are possible if NASA would plan, monitor and control its internal resources to the same degree it does its money for contractual services.

Implementation

The recommendation contained in this issue can be implemented by the NASA Administration. It is not a new recommendation, having been made by both OMB and GAO for over ten years. From the private sector perspective, we do not accept NASA's rationale for not implementing it, since implementation can only lead to improved management.

RESEARCH AND DEVELOPMENT (CONT'D)

R&D 8: COMPENDIUM OF SELECTED R&D ISSUES

Issue and Savings

What are the research and development (R&D) opportunities for cost savings or revenue generations identified by other President's Private Sector Survey (PPSS) Task Forces not discussed in detail in this Report?

Additional three-year savings/revenue generation of $32,984.2 million are projected from implementation of the 97 PPSS recommendations. These are primarily the result of improvements in strategic planning and R&D management and the budget process.

Background

This compendium consists of R&D issues not reported elsewhere in this Report. We have decided to include these savings as a compendium issue to portray the total benefit of R&D improvements identified by PPSS Task Forces. Including these savings as a compendium issue allows their inclusion without repetitious descriptions of similar kinds of improvements in a number of agencies.

The savings reported in the Issue and Recommendation Summaries are duplicated in other reports, but will be netted out in the President's report to avoid double counting. These recommended savings and revenue opportunities are presented here to demonstrate the importance of the Federal Government's need to focus on these opportunities.

Findings

In addition to the seven specific issues discussed previously, numerous other R&D issues were identified by PPSS task forces.

A review of these issues confirms that the R&D improvements most needed in Government are in the key areas of strategic planning and R&D management and budget cycle.

Conclusion

There are many agencies and applications that would benefit greatly from R&D management improvements. The number of these issues and savings/revenues represented support the Task Force's position that greater attention and improvement is needed Government-wide for R&D management.

Recommendation

R&D 8: The President, Congress, and specific agencies should take steps recommended by other PPSS Task Forces to improve R&D management.

Savings and Impact Analysis

Savings/revenues included in this compendium issue are listed in Exhibit II-15 on the following page.

Implementation

Implementation requirements can be found in the issues in each Task Force report.

[Exhibit II-15 on the following page]

Exhibit II-15

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
AG 49	Improve research activities.	3	$ 6.0	$ 8.2	$ 10.8	$ 25.0	S
AG 51	Establish National Research Board and realign regions.	2	76.0	83.6	91.9	251.5	S
AG 53	Transfer selected human nutrition research programs to HHS.	1	15.0	38.0	42.0	95.0	S
AG 54	Eliminate 8 percent contribution to funding of 20 low-priority research programs that can be funded by other than Federal sources.	1	10.7	11.8	12.9	35.4	S
USAF 3	Planning, programming and budgeting: Consolidate program and budget reviews thereby eliminating duplication of efforts.	3	2.4	2.6	2.9	7.9	S
USAF 19	Multiyear procurement (MYP): Expand use of MYP for weapons systems acquisition and revise budget priorities to accommodate more MYP.	2	800.0	800.0	800.0	2,400.0	S
ARMY 11	Procurement stability: Institute a biennial budget system for procurement of major weapons systems, with constraints designed to ensure that programs are managed in an informed, documentable way.	5	2,000.0	2,200.0	2,420.0	6,620.0	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
BUS-FTC 1	Restrict the scope of economic research to projects directly related to FTC mission.	9	$ 1.5	$ 1.6	$ 1.8	$ 4.9	S
BUS-TVA 7	Reduce appropriations for National Fertilizer Development Center Program; seek alternative sources of revenue such as user fees, special sales taxes on fertilizer, etc.; also reduce staff level and make administrative changes.	4	12.1	27.1	44.6	83.8	S
COMM 8	Enhance the process for reviewing National Bureau of Standards projects.	3	10.0	15.0	20.0	45.0	S
OSD 18	Independent R&D costs: These costs should be recoverable by defense contractors in the same manner as other bona fide overhead expenses. The burdensome regulatory process currently used should be eliminated, thus significantly reducing manpower and administrative costs.	1	100.0	110.0	121.0	331.0	S
OSD 19	R&D laboratories: Improve the exchange between the services and the defense research laboratories so that information on emerging technology developments can be better integrated into the appropriate phases of the weapons acquisition process. Coordination is also needed to eliminate duplication of staff and research efforts.	1	233.1	513.6	847.0	1,593.7	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
OSD 21	Weapon systems new starts: Install self-disciplinary limits on the number of new weapons programs started each year. Before a new start is approved, an estimate should be made of the projected cost of that new weapons system through production. Then, DOD should consider the impact of that incremental cost on the overall acquisition process -- in view of the limited funds for all weapons systems. Limits on new starts would help to ensure that sufficient funds are available to carry out all weapon programs economically and efficiently.	1	$ 222.9	$ 490.4	$ 809.2	$1,522.5	S
OSD 23	Instability in the weapons acquisition process: Commit to a stable five-year spending plan for the acquisition of weapons systems at economical production rates. DOD should focus the attention of Congress on any significant increase in costs that would result from proposals to change the plan. Critical to achieving such a plan for program stability is DOD's ability to relate financial affordability to proposed new systems early in the budgetary cycle. This would avoid accumulating systems that cannot be funded in economic production quantities during the entire production cycle.	2	1,051.5	2,313.3	3,816.9	7,181.7	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
ENERGY 11	Establish mission for multi-program national laboratories.	2	$ 0	$ 0	$ 0	$ 0	
ENERGY 12	Eliminate DOE overmanagement of contract R&D.	1	0	0	0	0	
ENERGY 13	DOE proposed three-year rolling R&D budget procedure.	1	125.0	137.5	151.2	413.7	S
ENERGY 14	Develop more DOE-industry interaction in R&D.	1	0	0	0	0	
ENERGY 15	Give priority to funding special nuclear materials and proceed with new production reactor.	3	0	0	0	0	
ENERGY 16	Support expeditious completion of defense waste processing facility.	2	0	0	0	0	
ENERGY 17	Terminate one of three current approaches to internal confinement fusion.	2	30.0	49.5	54.4	133.9	S
ENERGY 18	Utilize defense industrial security program versus more expensive current procedures.	2	15.0	16.5	18.1	49.6	S
EPA 6	Close six regional EPA laboratories.	1	(0.2)	10.3	11.4	21.5	S
EPA 7	Centralize research data base; cease funding for Centers of Excellence; conduct more cooperative research agreements in-house.	5	4.8	5.5	6.0	16.3	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
EPA 8	Close ADA research laboratory and Isle Field Station.	2	$ 2.2	$ 2.2	$ 2.5	$ 6.9	S
HHS 4	Eliminate the policy research of HHS department management.	2	13.9	15.3	16.8	46.0	S
HHS 5	Eliminate evaluation of projects within the Office of the Secretary.	2	10.5	11.6	12.7	34.8	S
HHS 7	Modify management practices and the organizational structure of HHS to improve social research.	4	20.0	22.0	24.2	66.2	S
PHS 1	Reduce administrative cost of NIH grants, contracts and equipment to universities which receive grants.	3	167.5	184.2	202.7	554.4	S
PHS 5	Consolidate Federal toxicology testing programs.	2	40.5	78.8	49.4	168.7	S
PHS 6	Eliminate inconsistencies in the NIH grants process.	2	5.2	5.7	6.3	17.2	S
PHS 8	Close the Rocky Mountain Laboratory of NIH.	2	2.9	5.3	5.9	14.1	S
NAVY 1	Limit number of programs put into production; fund management reserve to deal with fiscal emergencies and reduce stretch-outs; stabilize PPBS process; establish two-year budget cycle.	4	1,000.0	1,000.0	1,000.0	3,000.0	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
PRIV 3	Expand National Transportation System legislation to allow the private sector to invest in the fifth and future space shuttles and expendable launch vehicle systems; initiate Government/industry cooperation agreements to provide incentives for private investments.	2	$ 460.0	$ 506.0	$ 556.6	$ 1,522.6	S
PROC 4	Expand use of multiyear contracting in all Federal agencies; simplify budget process and utilize discounted cash flow methodology to evaluate the relative attractiveness of multiyear candidates.	5	500.0	1,100.0	1,815.0	3,415.0	S
PROC 6	Develop comprehensive Program Management and Acquisition Plan with expanded scope; use plan as basis for cost and schedule estimates; decentralize program management in accordance with approved plans.	1	300.0	825.0	1,815.0	2,940.0	S
DOT 1	Establish a new organization structure to encourage an overall R&D management approach; promote joint efforts in transportation R&D.	3	85.5	94.6	104.1	284.2	S

Exhibit II-15 (Cont'd)

R&D ISSUES COVERED IN OTHER REPORTS

Issue	Subject	Number of Recommendations	Savings/Revenues ($ millions) Year 1	Year 2	Year 3	Total	Savings(S)/ Revenue(R)
DOT 10	Consolidate Federal Railroad Administration R&D and safety functions; impose user fee schedules for system assessments and R&D services to railroads.	5	$ 5.0	$ 5.1	$ 5.2	$ 15.3	S
			13.2	21.7	31.5	66.4	R
	Total Savings (S)		$7,329.0	$10,690.3	$14,898.5	$32,917.8	S
	Total Revenue (R)		13.2	21.7	31.5	66.4	R
	Grand Total Savings and Revenue		$7,342.2	$10,712.0	$14,930.0	$32,984.2	

III. SUMMARY LIST OF RECOMMENDATIONS AND SAVINGS

III. SUMMARY LIST OF RECOMMENDATIONS AND SAVINGS

This section summarizes the annual and cumulative savings for each issue in the report.

The authority required to implement the individual recommendations is also shown according to the following legend:

A -- recommendations can be implemented under the existing authority of the agency.

P -- recommendations can be implemented under the existing authority of the President.

C -- recommendations can be implemented by action of the Congress.

III. SUMMARY LIST OF RECOMMENDATIONS AND SAVINGS

THREE-YEAR COST SAVINGS (S)/REVENUE (R)/CASH ACCELERATION (CA) OPPORTUNITIES

Issue	Recommendations	Implementation Authority 2/	Savings (S)/Revenue (R)/Cash Accelerations (CA) 1/ ($ millions) Year One	Year Two	Year Three	Three-Year Total
R&D 1	Strategic Planning					
	Develop statements of goals; develop improved strategic planning concepts & procedures; and use strategic planning for subsequent operational management.	A	$2,200.0	$2,400.0	$2,700.0	$7,300.0 (S)
R&D 2	R&D MGT and the Budget Process					
	Implement multiyear budgeting for R&D; develop budget concept to reduce level of detail; shorten budget cycle; and reduce technical staff positions in all R&D agencies.	C	1,110.0	1,220.0	1,340.0	3,670.0 (S)
R&D 3	Privatization					
	Identify privatization opportunities; identify R&D activities which compete with private sector; and encourage private sector participation.	A				3/
R&D 4	Laboratories					
	Form additional centers of excellence; form a laboratory evaluation team; study lab consolidation; Directors of labs should have more budget control; create a scientific/technical personnel system; reclassify facilities and remove exemptions from A-76.	A,C	153.0	168.3	185.1	506.4 (S)

THREE-YEAR COST SAVINGS (S)/REVENUE (R)/CASH ACCELERATION (CA) OPPORTUNITIES

Issue	Recommendations	Implementation Authority 2/	Savings (S)/Revenue (R)/Cash Accelerations (CA) 1/ ($ millions) Year One	Year Two	Year Three	Three-Year Total *
R&D 5	Administration of Research Grants to Universities					
	Negotiate indirect cost rates that include fixed amount for departmental administration; encourage agencies to implement new funding and grant administration mechanism; and develop simplified method for determining indirect rates for universities with less than $10 million total grants.	A	$117.2	$128.9	$141.8	$387.9 (S)
R&D 6	Research Program Reporting					
	Expand NTIS; make use of NTIS data base mandatory; require that research performers supply material; require that research performers supply material; and require that research performers utilize data base before initiating new research.	A	(4.0)	71.0	158.5	225.5 (S)
R&D 7	NASA Cost Reporting					
	Expand project management system to cover all resources.	A				3/
R&D 8	Compendium Issue	A,C,P	7,329.0 13.2	10,690.3 21.7	14,898.5 31.5	32,917.8 (S) 66.4 (R)
	Total Cost Savings (S) Total Revenue (R)		$10,905.2 $ 13.2	$14,678.5 $ 21.7	$19,423.9 $ 31.5	$45,007.6 (S) $ 66.4 (R)
	Total Cost Savings and Revenue		$10,918.4	$14,700.2	$19,455.4	$45,074.0

1/ Amounts in this summary include inflation and are net of implementation cost.
2/ Implementation Authority: Agency (A), President (P), Congress (C).
3/ Recommendation not quantified.

IV. COST CONTROL OPPORTUNITIES FOR FURTHER STUDY

IV. COST CONTROL OPPORTUNITIES FOR FURTHER STUDY

A. UNIFORM PATENT AND TECHNICAL DATA POLICY

Issue

Can a revised patent and technical data policy improve the transfer of Government-funded innovation to industry and enhance cooperative research projects between Government and the private sector?

Background

Patents -- The lack of a uniform patent policy resulted in the issuance of the Presidential Memorandum and Statement of Government Patent Policy in 1963. This memorandum was revised in 1971, providing further guidance to agencies for assigning title to inventions resulting from Federally funded research. These attempts toward uniformity have been relatively unsuccessful and policies have been developed over the years on an agency-by-agency basis. There are wide variances in the way agencies have interpreted the Presidential policy, vesting title to inventions in the Government in one instance and in the contractor in another. There has also been piecemeal legislation that further complicates implementation of this policy. In fact, there are 20 different patent arrangements used by the agencies.

The 96th Congress enacted P.L. 96-517, providing that in most cases a nonprofit organization or small business firm may elect to retain title to inventions made during Federally sponsored research and development (R&D). Pending bills would extend P.L. 96-517 to all Government contractors (Schmitt Bill, S. 1657 and Ertel Bill, H.R. 4564).

Technical data -- The Government needs many kinds of technical data, particularly in the Department of Defense (DOD), from the simplest gadget to the most sophisticated equipment. To maintain competition among suppliers and to further economy in Government procurement, these data are available, with certain exceptions, in the form of contract specifications.

The Government has unlimited rights to all data resulting from Government-sponsored research and development,

whether it be totally financed or a joint venture with a contractor. If data are developed at the contractor's expense, then the Government is responsible for keeping it secret; its disclosure to competitors could jeopardize the competitive advantage it was developed to provide. The Government has limited rights to this data which should not be transferred to a third party under the Freedom of Information Act (FOIA). Any public disclosure of technical data can cause serious economic hardship to the originating company.

License -- The Federal Government has a portfolio of 28,000 to 30,000 patents. Less than 10 percent of them have been licensed to private producers. The Government also follows a practice of filing patent applications for inventions with little or no commercial value. Under present legislation and Defense Acquisition Regulation, the contractor can request a waiver of title to inventions, thereby vesting title to the invention in the contractor rather than the Government (when the invention results from Government-sponsored R&D).

Methodology

The following approach was taken to develop and validate the conclusions reached:

- Present agency practices were determined through literature review and interviews with agency patent and technical data personnel.
- Present and pending legislation was reviewed.
- Objectives were discussed with drafters of the new Federal acquisition regulations.
- Industries' concerns were reviewed and evaluated.
- The above information was analyzed.

Findings

The lack of a uniform patent and technical data policy results in the following:

- There are 20 different patent arrangements used by the agencies.
- Major contractors do not have access to Government-sponsored innovation.

- There is a reluctance in the private sector to make use of Government-sponsored innovation in the absence of exclusivity.

- Many contractors are reluctant to transfer their proprietary data to the Government for fear of disclosure to competitors. Also, many contractors will not accept Government contracts because they fear the disclosure of sensitive technical data. These fears confirm the need for legislation or regulations that would guarantee the contractor protection from disclosure. This type of law would improve the working relationship between Government and the private sector and further ennance competitive bidding.

- DOD waives title to 90 percent of Government-sponsored innovation back to the contractor, while the National Aeronautics and Space Administration and Department of Energy waive 85 percent and 80 percent, respectively. Most contractors only request a waiver for inventions with some commercial value. The Government usually files patent applications for the remaining inventions, resulting in a Government patent portfolio with a large percentage of patents with no commercial value. For instance, of the 7,000 patent applications filed by DOD from 1976 to 1981, about 40 percent are contractor generated and the remaining 60 percent are generated by DOD employees. Also, 90 percent of the licenses granted are for employee-generated inventions.

- At present, there is no legislation affecting the rights to technical data. There is, however, P.L. 96-517 pertaining to patent rights in small businesses and universities.

Conclusions

A uniform, clear patent and technical data policy would stimulate innovation, productivity and commercial use of Government-funded innovations. It would also reduce the administrative burden on the agencies and contractors and increase the willingness of contractors to enter into Government contracts.

Recommendations

Patent Policy Needs -- The Task Force supports the following recommendations on patent policy:

- Support the Schmitt Bill. However, should the Schmitt Bill not pass, the 1971 Presidential Statement on Patent Policy snould be revised to require agencies, where not precluded by law, to give the first option to ownership of inventions made in performance of a Government contract to the inventing contractor.

- Support a policy of defensive patent or defensive publication in lieu of a regular patent. This policy would require the agency to state clearly whether it will file a defensive patent or defensive publication or a regular patent application. If the agency elects to file a regular patent application, the invention should be subjected to a coordinated screening process to determine its commercial value.

- The screening process should be coordinated with a licensing program. Government licensing should be consolidated into a single agency. The single agency should also have primary responsibility for transferring that tecnnology to the private sector.

- Inventions should be classified in a catalog based on field of technology.

Tecnnical Data -- For technical data matters, the Task Force recommends tne following:

- Data developed completely at private expense confers on tne Government limited rights to the data. The Government should not release that data to a third party under FOIA.

- Contractors snould maintain rights to background data developed by the contractor at the contractor's expense prior to entering into a Government contract. The Government should have specific rights to all other data. If background information is turned over to the Government, it must be treated as limited rights data.

- Contractors should retain all commercial rights to all data first produced under Government contract. The Government would have a license for limited purposes such as reprocurement,

evaluation and similar needs. This data should not be disclosed without having a specific Government purpose or without the agreement of the contractor.

Savings and Impact Analysis

A policy of defensive patent filing or defensive publication would:

- o decrease the number of useless patents in the Government portfolio;
- o reduce the related cost of filing patent applications;
- o reduce the burden in the patent office as required by agency filing; and
- o provide the same defensive protection as a regular application.

Consolidation of Government licensing in a single agency would prevent fragmentation and inconsistency in the licensing process.

Passage of the Schmitt Bill would vest title to Government-sponsored R&D in the major contractors, thereby enhancing the relationship between Government and major contractors. It would also stimulate the commercialization of innovation (P.L. 96-517 gives small businesses and universities title to Government-sponsored innovation and has been well received by the parties involved). Also, the number of inventions reported by these contractors has increased significantly.

Contrary to FOIA, the Government should not disclose to third parties data developed solely at private expense. Confidentiality would (a) encourage inventors to share their information with the Government; (b) make more innovation available to the Government; and (c) significantly encourage competitive bidding. At present, many contractors refuse to enter into Government contracts for fear of the Government's disclosure of sensitive proprietary data.

Implementation

The above recommendations can be implemented through legislation (Schmitt Bill), through a revised Presidential statement on patent policy, and through a Presidential statement on rights in technical data.

B. MEASURING R&D OUTPUTS

Issue

Can research and development (R&D) management in the Federal Government be strengthened if increased attention is given to developing and employing quantitative measures of R&D performance?

The lack of such measures, particularly in basic and applied research areas, leads to a lack of precision in managing R&D. In particular, Government science policy formulation, project selection and program evaluation can benefit from the increased use of quantitative measures.

While it seems likely that the use of quantitative performance measures can make the R&D management process more efficient and effective, it is difficult to ascertain the nature of savings opportunities generated by their use.

Background

The history of modern management shows that one of its outstanding traits has been the attempt to rationalize decision-making in organizations. Management historians often identify the origins of modern management with the turn of the century work of Frederick W. Taylor who, with his concept of scientific management, attempted to apply scientific principles to organizing the management process. For example, he called for management to collect data on the work place, "... recording it, tabulating it, reducing it in most cases to rules, laws, and in many cases to mathematical formulae."1/

The drive to rationalize management through quantification has met with only limited success in the R&D area.

1/ F.W. Taylor, "The Principles of Scientific Management," in Boone and Bowen (eds.), The Great Writings in Management and Organizational Behavior (PPC Books, 1980), p. 43.

It has been applied more successfully to the management of technology than the management of science. Even within technology, its effective use has been spotty.

The degree of success or lack of success in applying quantitative techniques to the management of R&D seems to be rooted in two factors: the level of uncertainty in an R&D project and the availability of measures of R&D performance. In the first instance, the higher the level of certainty associated with a project, the more amenable it is to quantitative management. Thus, heavily used quantitative techniques, such as Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) are very useful in large scale projects whose tasks can be accomplished with an established degree of certainty, but may be of very limited value to more basic research projects whose outcomes are only vaguely predictable.

With the availability of R&D performance measures, we find, not surprisingly, a positive correlation between the availability of quantitative measures of R&D performance and the extent to which they are employed for R&D management purposes. In general, the nearer a project is to the development end of the spectrum, the more measures there are that are available. Typically, there are technical performance indicators (e.g., How fast does a newly developed aircraft fly? How far can it travel without refueling? What is its rate of climb?), or business (or organizational) performance indicators (e.g., How much does the new technology contribute to organizational profitability? To cost reductions in manufacturing? To increases in labor productivity? To increases in market share?). In the sciences, the only readily available performance indicators are those associated with research publications (e.g., counts of scientific articles, citations, coauthorships).

Methodology

Interviews were conducted with key evaluation people in several agencies, as well as with some of the central individuals involved with developing quantitative indicators of scientific and technological effort. Relevant literature was reviewed.

Findings

Little effort is being made in the Federal Government to develop and refine quantitative measures of scientific and technological performance. Only two agencies seem to

have made an explicit commitment to encouraging their development: the National Science Foundation (NSF) and the National Institutes of Health (NIH).

Within NSF, the Science Resource Studies Division (SRS) and the Science Indicators Unit are explicitly charged with developing and using quantitative indicators. SRS maintains and collects a wide array of science and technology (S&T) statistics. It is primarily through its efforts that we have any idea at all of the quantitative dimensions of S&T in the U.S. It serves as the principal repository of data on such things as S&T manpower, employment, expenditures, and education. In addition to maintaining and publishing R&D statistics, SRS supports extramural research designed to more fully exploit existing data and to push forward the state-of-the-art of indicators development.

The Science Indicators Unit is responsible for publishing the Science Indicators reports every two years. These reports provide the most comprehensive statistical summary that exists of U.S. scientific and technological activity. They also contain a comprehensive chapter on international indicators. In addition to publishing the reports, the Science Indicators Unit commissions studies on the strengths and weaknesses of different indicators.

NIH does not have any divisions analogous to SRS or the Science Indicators Unit. Nonetheless, it has been an important supporter of indicators development for basic and applied research. The Program Planning and Evaluation group in the Director's Office has been supporting the development of measures of scientific output for over a decade. Individual institutes, such as the National Heart, Lung, and Blood Institute (NHLBI), have also supported efforts to develop better science indicators. The reason for substantial NIH interest in developing good measures of scientific performance is a desire to be able to evaluate the outcome of billions of dollars of biomedical research supported by the agency each year.

On a much smaller scale than NIH or NSF is the Office of Technology Assessment and Forcecast (OTAF), which is trying to develop patent data for the purpose of examining both domestic and foreign technological events. OTAF has undertaken a number of studies that identify the most prevalent patenting areas in the U.S. today, as well as identify where foreign firms are making the most significant technological inroads in the U.S.

All the efforts described here are laudable. The problem is that together they are too small to lead to the

development of a true system of interrelated, easily accessed, detailed R&D statistics. Without such a data network, it is unlikely that quantitative measures of scientific and technological performance can have widespread application.

Policy uses of S&T performance indicators can be substantial. It is inconceivable today that economic policy would be made without heavy dependence upon analyses of economic indicators. Rising inventory levels are one indication that the economy may be entering a recession. Increased capital spending may suggest that a sick economy is recovering. Increases in the money supply portend inflationary pressures, while decreases may contribute to rising interest rates. Examination of these indicators gives us some idea of what is happening in the economy today and may suggest future courses of action.

While it is unlikely that S&T indicators could ever assume the significance of economic indicators, it certainly seems plausible that they could play an important role in guiding science policy formulation in the U.S. Some of these indicators are in fact now used as inputs into policy formulation, but their use is generally haphazard.

There are two principal ways in which quantitative indicators of scientific and technological performance can be very useful in the making of American science policy. First, they have a purely domestic use, telling us where we have come from and possibly suggesting where we are going. Second, they can be important in alerting policymakers to foreign scientific and technological activity that can have commercial, foreign policy and military implications.

Domestic Policy Uses of Scientific and Technological Indicators -- If we had a well-developed, comprehensive body of indicators of national scientific and technological performance, we could have a good idea of national S&T capabilities, both in the recent past and at the present time. This information could serve as a guide suggesting where we are heading. If we do not like the projected future directions of S&T, we can implement policies to modify them.

For example, measures of current enrollments in, say, university biochemistry programs coupled with information on the number of biochemists presently employed in the Government, nonprofit, for-profit, and university sectors; data on published biochemical research; and present

research funding levels in biochemistry can give planners a very good idea of the potential state of American biochemistry efforts five years from now.

Consider also the following concrete example: During the years following the oil embargo, the Department of Energy (DOE) and its predecessors focused a great deal of attention on alternative energy sources. One problem it faced in managing R&D in alternative energy areas was its lack of knowledge of who was already doing research in the target areas, the general dimensions of their efforts, and the specific contents of ongoing activities. DOE was able to obtain a good grasp of coal gasification R&D activity by tabulating information from existing data sources on all articles, reports, and patents related to coal gasification. It was even able to identify R&D activity occurring overseas. One product of the investigation is presented here as Exhibit IV-1, on the following page, which shows the organizations most active in undertaking coal gasification R&D efforts.

Monitoring Foreign Scientific and Technological Activity -- For a long time after World War II, roughly half of the world scientific and technological effort was undertaken in the U.S. Americans dominated world science and technology like no other country in history. However, beginning in the 1970s, it became clear that the absolute dominance of the Americans was on the wane. It was not so much that American R&D capabilities were deteriorating; rather, the rest of the world was catching up to the U.S. As a consequence, American products no longer enjoyed the advantage of being the best engineered products in the world. This contributed to a loss of market share in international markets. In more recent items, high-quality, low-cost technology based products have even made serious inroads in the United States marketplace. The automobile and consumer electronics industries have been particularly hard hit by technology-based competition from Japan.

Scientific and technological indicators can provide policymakers with valuable information on foreign S&T activity abroad, as well as inside the United States. Of particular value are patent indicators. Anyone monitoring these indicators in the mid-1960s would have found that foreign individuals and organizations accounted for only 20 percent of all U.S. patents. Today, however, they account for 41 percent. Particularly revealing is the fact that 14 percent of U.S. patents are currently held by Japanese organizations and individuals.

[Exhibit IV-1 on the following page]

Exhibit IV-I

INSTITUTIONS HAVING THE GREATEST NUMBER OF PUBLICATIONS IN COAL GASIFICATION

Private Sector	No. of Pubs
Institute of Gas Technology	68
Battelle Columbus Laboratories	25
Westinghouse Electric Corp.	24
Bituminous Coal Research	23
Exxon Research & Engrng.	20
Consolidation Coal Co.	20
General Electric Co.	14
Koppers Company	13
Parsons Company	12
Chemical Systems Inc.	12
University Sector	
City College of New York	12
Brignam Young University	10
West Virginia University	8
Carnegie-Mellon University	8
University of Michigan	8
Pennsylvania State University	7
Iowa State University	7
University of Kentucky	6
Purdue University	6
University of North Dakota	4
Government Sector	
DOE/ERDA/BM/OCR	83
Lawrence Livermore Labs	56
Pittsburgn Energy Research Center	39
Morgantown Energy Research Center	30
Oak Ridge National Laboratory	23
Sandia Laboratories	19
Laramie Energy Research Center	17
Argonne National Laboratory	15
Los Alamos Science Laboratory	7
Atomic Energy Commission	7

Exhibit IV-2, on the following page, illustrates the great level of detail that patent indicators can provide policymakers regarding foreign patenting in the U.S. It is a patent profile for the Sony Corporation and shows the areas in which this company has taken out patents in the U.S. Inasmuch as Sony does not advertise its technology strategy in the U.S., this patent profile gives policymakers unobtrusive insights into what that technological strategy might be.

Agencies can use measures of R&D outputs to evaluate the effectiveness of their programs. In 1982, the Federal Government spent some $13.3 billion to support basic and applied research. It is quite difficult to evaluate whether or not this money was well spent, since the outputs of scientific research are notoriously hard to evaluate. Ideally, the output measures would tell us that a given piece of research resulted in certain tangible benefits. However, this is rarely the situation; basic and applied research infrequently have clear-cut, measurable, useful results.

However, scientific research often results in the publication of scientific papers which describe the research findings. In recent years, counts of scientific papers have become an accepted measure of scientific output. Universities, for example, have long assessed the publication productivity of their faculties, especially when making promotion and tenure decisions -- the famed "publish or perish" approach.

While counts of published papers do not tell us anything about the usefulness of research, they do give us an idea of the degree to which research efforts result in findings that are deemed worthy of reporting in refereed journals. Furthermore, we can obtain insights into how influential (or visible) a given research effort is by seeing the extent to which the papers it produces are heavily cited in the scientific literature. The theory here is that heavily cited papers are in some sense important, while poorly cited papers are not. Literature indicators are imperfect measures of scientific productivity. However, they at least give research managers some idea of the output of research undertakings, and this can be important in assessing the worth of large and varied research programs.

Exhibit IV-3 shows one application of using literature indicators to evaluate the research efforts of Government laboratories. The data presented in this table are heavily aggregated. However, they can be examined at a

[Exhibits IV-2 and IV-3 on following pages]

Exhibit IV-2

SONY CORP. TECHNOLOGY (PATENT ACTIVITY) PROFILE FOR YEARS 1971 to 1980 USING U.S. PATENT OFFICE CLASSIFICATION SYSTEM

BAR GRAPH OF THE NUMBER OF PATENTS FOR CLASSES WITH AT LEAST FIVE PATENTS

---CLASSIFICATION---	# PATS	A.I.	NUMBER OF PATENTS (100, 200, 300)
029 METAL WORKING	14.00	0.79	III
148 METAL TREATMENT	15.00	2.26	IIII
156 ADHES. BOND. & MISC. CHEM	5.00	0.41	I
179 TELEPHONY	49.50	4.87	IIIIIIIIIIII
204 CHEM.,ELECT. & WAVE ENERG	19.00	1.38	IIIII
206 SPECIAL RECEPT. OR PACKAG	6.00	0.81	I
242 WINDING AND REELING	42.00	4.39	IIIIIIIIIII
307 ELECT. TRANSMIS.,INTERCON	56.00	4.99	IIIIIIIIIIIIII
310 ELECT. GENER., MOTOR STRU	8.00	1.25	II
313 ELECT LMP & DISCH. DEVICE	51.00	7.97	IIIIIIIIIIIII
315 ELECT LMP & DISCH. DEVS.,	41.00	6.64	IIIIIIIIII
318 ELECT,MOTIVE POWER SYSTEM	16.00	2.15	IIII
323 ELECT,POWER SUPPLY,REGULA	9.00	4.68	II
324 ELECT,MEASURING & TESTING	13.00	1.39	III
329 DEMODULATORS & DETECTORS	11.00	15.18	II
330 AMPLIFIERS	74.00	20.82	IIIIIIIIIIIIIIIIIII
331 OSCILLATORS	19.00	3.32	IIIII
332 MODULATORS	5.00	6.10	I
333 WAVE TRANSM. LINES & NETW	11.00	2.42	II
338 ELECTRICAL RESISTORS	7.00	3.25	I
340 COMMUNICAT.,ELECTRICAL	24.00	1.39	IIIIII
343 COMMUNICAT.,RADIO WAVE	5.00	0.58	I
350 OPTICS,SYSTEMS & ELEMENTS	5.00	0.45	I
357 ACTIVE SOLID STATE DEVICE	67.00	11.25	IIIIIIIIIIIIIIIII
358 PICTORIAL COMMUNICAT.; TV	230.00	23.42	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
360 DYNAMIC MAGNET. INF. STOR	172.50	25.22	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
361 ELECT,ELECTR. SYSTS. & DE	22.00	2.50	IIIII
363 ELECT POWER CONVER SYSTEM	22.00	7.68	IIIII
364 ELECT COMPUT. & DP SYSTEM	5.00	0.37	I
369 DYNAMIC INFO. STORAGE OR	53.00	22.18	IIIIIIIIIIIII
371 ERROR DETEC/COR & FAULT D	6.00	3.54	I
428 STOCK MATERIAL OR MISC. A	12.00	0.79	III
430 RADIATION IMAGERY CHEM.-P	5.00	0.43	I
455 TELECOMMUNICATIONS	64.00	14.95	IIIIIIIIIIIIIIII

Source: Computer Horizons, Inc., Cherry Hill, N.J.

Exhibit IV-3

NUMBER OF SCIENTIFIC PAPERS PRODUCED BY FEDERAL LABORATORIES

	Clin Med.	Biomed. Research	Biology	Chemistry	Physics	Earth/ Space	Engineering Technology	Math
DOD	1,839 (-8.4)	392 (-11.0)	111 (3.5)	375 (-3.7)	936 (-5.8)	310 (-2.5)	909 (5.1)	76 (-2.8)
Federal Civilian Agencies	5,629 (4.6)	2,736 (2.1)	4,022 (-0.6)	1,141 (-1.1)	722 (-6.9)	1,414 (1.8)	1,311 (5.3)	87 (5.0)
NIH Intramural	2,041 (11.4)	1,379 (10.8)	65 (16.7)	133 (22.4)	-	-	-	-

Note: Numbers in parentheses represent the extent to which papers appeared in the top quartile (25%) of all papers produced by Government and industrial labs, where these papers were ranked according to the number of citations they received. Thus (3.2) roughly means that 3.2% more papers than the norm were heavily cited, while (-3.2) means that 3.2% fewer papers than the norm were heavily cited.

Source: Computer Horizons, Inc., Cherry Hill, New Jersey.

disaggregated level as well, so that it is possible to determine, for example, how many papers are produced by the Fermi National Laboratory in nuclear and particle physics, as well as to determine how heavily these papers are cited.

Data such as these must be interpreted very carefully. For instance, the fact that a given weapons lab does not produce papers that are highly cited does not mean that it is not adequately meeting its mission. It does suggest, however, that the published research it produces is not very influential in the scientific community.

Exhibit IV-4 shows how literature indicators can be used to evaluate Government-supported research at the program/project level. The exhibit contains actual data used in comparing two different programs in an agency. Each program is multidisciplinary, supporting a wide range of extramural projects. As the exhibit shows, the literature indicators for Program A are consistently stronger than for Program B, confirming the general consensus in the agency that Program A is scientifically stronger than Program B.

There are many additional ways in which literature indicators can be used for evaluative purposes. As output indicators, they can be compared to input indicators (e.g., funds, manpower) to come up with a measure of R&D efficiency. They can be used to model the entire Government-supported research system to determine, for example, the effects of funding cuts on immunology research in oncology.

Conclusions

Measures of R&D can serve a useful purpose in both science policy formulation and the management of R&D at the program/project level. A review of the uses of economic indicators in business and Government planning and evaluation suggests that a well-developed, comprehensive body of R&D indicators may be able to serve many varied and important functions.

The utility of R&D indicators has been realized only in recent years with the computerization of many R&D related data files. In particular, the computerization of scientific and engineering indexes/abstracts, library holdings, bibliographies, as well as the computerization of the U.S. patent files, has provided planners and evaluators with useful measures of R&D outputs. Yet many data files

[Exhibit IV-4 on following page]

Exhibit IV-4

QUANTITATIVE COMPARISON OF TWO MULTIDISCIPLINARY PROGRAMS

	Program A	Program B
Age	46.5	47.8
Years since degree	19.4	17.6
EDUCATION		
Ph.D/D.Sc	87.3%	95.6%
M.D.	9.4	2.2
Ph.D./M.D.	1.1	0.0
M.S.	2.2	2.2
PUBLICATIONS/YEAR/SCIENTIST		
Life Sciences	3.22	2.82
Physical Sciences	2.21	1.63
Social Sciences	1.00	0.57
Engineering Sciences	1.89	0.93
Agriculture Sciences	2.19	1.63

Source: J.D. Frame, "Quantitative Indicators for Evaluation of Basic Research Programs/Projects," IEEE Transactions on Engineering Management, vol. 30 (August 1983).

of potential value have not been exploited. For example, in order to get a better quantitative grasp of DOD supported R&D activities, computerized project files can be tapped to generate R&D measures (e.g., the Defense Documentation Center's Work Unit Information System can be employed). Similarly, DOE's RECON information system can serve to generate indicators of R&D effort in energy areas.

A budget of $44.3 billion is inherently difficult to manage. If budget allocations, R&D plans, evaluations of activities, etc. are made primarily on a subjective, qualitative basis, it is certain that the R&D system will be filled with inefficiencies. To the extent that valid, reliable and useful measures of R&D activity can be developed, the management process will be strengthened.

Recommendations

Investigate the state-of-the-art in R&D indicators development with a view to determining how these indicators can be employed to strengthen Federal management of R&D activities.

Support development of a comprehensive system of R&D indicators. The system should be roughly modeled after the existing system of economic indicators. Attention should focus on developing indicators at a fine level of detail. The system should be able to answer questions such as: How many molecular biologists work in the private sector? How many undergraduate students are enrolled in electrical engineering programs? What Government laboratories are most active in superconductivity research? How productive are scientists working in NHLBI labs in comparison with researchers in leading medical school cardiology departments? To what extent do French scientists have a lead over American scientists in breeder reactor technology?

Savings and Impact Analysis

The principal impact of instituting a comprehensive system of quantitative R&D measures would be to strengthen management of the multi-billion dollar Federal R&D effort. At the very least, such a system would give Government R&D managers and policymakers a fairly precise idea of the dimensions of R&D in the United States. As such, it would help Government to improve control over its R&D inventory. At best, such a system would give policymakers and managers the ability to fine tune the management of Federal R&D efforts. Unfortunately, it is very difficult to determine the level of cost savings that such a system would realize.

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